Australian Government
Department of Climate Change, Energy, the Environment and Water

# Australia's emissions projections 2023

November 2023

**Cataloguing data**

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**Acknowledgement of Country**

Our department recognises the First Peoples of this nation and their ongoing connection to culture and country. We acknowledge Aboriginal and Torres Strait Islander Peoples as the Traditional Owners, Custodians and Lore Keepers of the world's oldest living culture and pay respects to their Elders past, and present.

**Feedback**

The Department of Climate Change, Energy, the Environment and Water welcomes feedback regarding Australia's emissions projections at Emissions.Projections@dcceew.gov.au.

# Executive Summary

*Australia's emissions projections 2023* provides the latest estimates of Australia's future greenhouse gas emissions to 2035. They show how Australia is tracking against its 2030 emissions reduction commitments by examining the potential impacts of policies and measures to reduce Australia's greenhouse gas emissions.

Australia's 2030 target is both a single year commitment to reduce emissions to 43% below 2005 levels, and a multi-year emissions budget from 2021 to 2030. Both targets are legislated in the *Climate Change Act 2022*. They form part of Australia's Nationally Determined Contribution (NDC) to the United Nations Framework Convention on Climate Change (UNFCCC). The 2030 target sets a floor, not a ceiling, on Australia's ambition. It is the next waypoint towards Australia's net zero emissions by 2050 commitment.

The 2023 emissions projections show stronger progress towards the 2030 target than the 2022 emissions projections. Under the baseline scenario, the 2023 emissions projections indicate Australia will achieve a 37% reduction on 2005 levels by 2030. This compares to a 32% reduction on 2005 levels in the 2022 emissions projections.

The 'with additional measures' scenario incorporates additional policies that have been announced but where detailed design is still under consultation. Under this scenario, Australia's emissions are projected to be at 42% below 2005 levels by 2030. This compares to a projection of 40% below 2005 levels in the 2022 emissions projections.

In terms of Australia's emissions budget, the baseline scenario indicates emissions will be 1% above the budget. Under the 'with additional measures' scenario, Australia's emissions are projected to be 1% below the budget. That is, Australia is expected to do better than its 2030 target on a budget basis under the 'with additional measures' scenario.

**Table 1 Tracking towards Australia's 2030 point target**

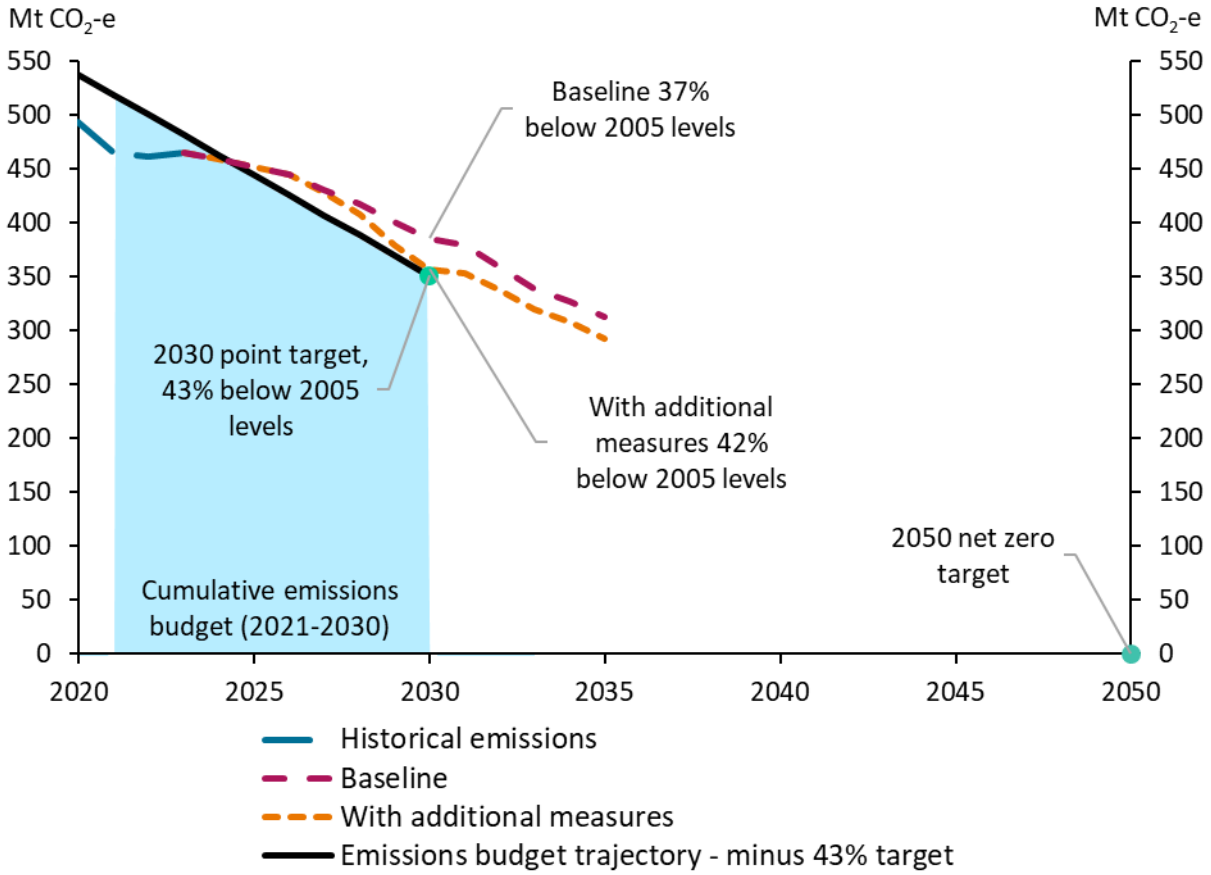
| | Emissions in 2030, Mt $CO_2$-e | % below 2005 |
|---|---|---|
| 2030 Target | 351 | 43% |
| Baseline scenario | 387 | 37% |
| 'With additional measures' scenario | 358 | 42% |

**Table 2 Tracking towards Australia's 2030 emissions budget target**

| | Cumulative emissions, 2021-2030 Mt $CO_2$-e | % above/below emissions budget |
|---|---|---|
| 2021-2030 emissions budget | 4,353 | - |
| Baseline scenario | 4,392 | 1% |
| 'With additional measures' scenario | 4,322 | -1% |

Under the baseline scenario, emissions in 2035 are projected to nearly halve (decline by 49%) from 2005 levels. This improves in the 'with additional measures' scenario to a reduction of 53% on 2005 levels by 2035.

**Figure 1 Tracking against the 2030 target, 2020 to 2050, Mt $CO_2$-e**




The emissions projections take account of the latest information on economic activity, domestic and international demand for Australian energy, resources and agricultural products, as well as technology costs and uptake.

The baseline scenario includes federal and state and territory policies which have been implemented or where detailed design is well progressed. New policies that have been incorporated since the 2022 emissions projections include:

- the Safeguard Mechanism reforms and support provided under the Safeguard Transformation Stream of the Powering the Regions Fund
- the announced pilot tenders under the Capacity Investment Scheme (CIS) as per public announcements to August 30th, 2023
- the updated Victorian Renewable Energy target of 65% by 2030 and 95% by 2035
- the Household Energy Upgrades Fund announced at the 2023-24 Budget; and
- elements of the National Electric Vehicle Strategy including the Fringe Benefits Tax exemption on electric vehicles (EVs).

The 'with additional measures' scenario includes the 82% renewable electricity target and further measures under the National Electric Vehicle Strategy, principally a fuel efficiency standard for light vehicles. These policies have been announced but were undergoing continued detailed design and consultation at the time of finalising the 2023 emission projections. In particular, the expansion of the Capacity Investment Scheme to support 32 GW of capacity and renewable generation announced on 23 November 2023 will be central to delivering the 82% target, but is not yet in the baseline

scenario. It will move into the baseline scenario as it is fully implemented, as has happened with the Safeguard Mechanism reforms since the 2022 Projections.

Some announced Commonwealth policies were not included in the 'with additional measures' scenario. This is because their emission reduction impact is dependent on the outcome of grant rounds yet to be run or investment decisions yet to be made. These include Hydrogen Headstart, the National Reconstruction Fund, and other streams of the Powering the Regions Fund (Industrial Transformation and Critical Inputs to Clean Energy Industries streams).

From 2023 to 2030, emissions are projected to decline in almost all sectors of the economy in the baseline and 'with additional measures' scenario. Electricity sector emissions decline by nearly half (46%) between 2023 and 2030 in the baseline. This is because of progressive replacement of fossil fuel generation by renewables supported by federal, state and territory renewable energy targets and plans. Electricity emissions are projected to fall even further – by 60% between 2023 and 2030 – in the 'with additional measures' scenario with the inclusion of the 82% renewable electricity target.

Declines in emissions from the stationary energy, fugitives and industrial process and product use sectors are also projected. This is largely driven by investments in efficiency and technology improvements incentivised by the Safeguard Mechanism reforms.

In the baseline scenario, transport sector emissions are projected to increase to 2030 as travel activity returns to pre pandemic levels. After 2030, transport emissions are projected to decrease as the impact of EV uptake grows. When further measures under the National Electric Vehicle Strategy are included in the 'with additional measures' scenario, transport emissions instead fall by 4% between 2023 to 2030 and by 15% between 2030 and 2035.

The land use, land use change and forestry (LULUCF) sector is projected to remain a net sink to 2030 (that is, more carbon is projected to be sequestered than emitted from this sector each year). From a peak of -64 million tonnes of carbon dioxide equivalent (Mt $CO_2$-e) in 2023, the net carbon sink is projected to decrease as the onset of the El Niño period reduces forest regrowth.

The net sink in the land sector is then expected to remain relatively stable and be -56 Mt $CO_2$-e in 2035. The trends in the land sector to 2035 are driven in large part by an overall reduction in native forest harvesting driven by policies in Western Australia and Victoria; continued lower levels of land clearing; and sequestration activities under the Australian Carbon Credit Units (ACCU) scheme.

The 2030 target is the next waypoint in Australia's efforts to reach net zero emissions by 2050. The 2023 emissions projections show material progress towards the 2030 target. However, these outcomes will depend on effective implementation of existing and announced government policies.

Sustained and broadened efforts will be needed to decarbonise Australia's economy to 2050. Assuming the 2030 target is met, Australia's net emissions would need to decline by 18 Mt $CO_2$-e a year on average to meet its net zero emissions target by 2050.

Australia's national inventory and emissions projections are prepared in accordance with international guidelines agreed for use for reporting under the Paris Agreement.

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# Overview of the emissions projections results

## Introduction

The annual emissions projections provide estimates of Australia's future greenhouse gas emissions to 2035, and assess how Australia is tracking against its legislated emissions reduction targets of a 43% reduction on 2005 levels by 2030 and net zero by 2050.

The annual emissions projections also assess the expected drivers of future emissions, and outline national level and sectoral emissions trends to 2035 to meet international reporting requirements. Historical and projected emissions are presented from 1990 to 2035. These projections update *Australia's emissions projections 2022*, which were published in December 2022.

The *Methodology for the 2023 emissions projections* provides a detailed description of the methods applied in the preparation of, and key data inputs to, the 2023 emissions projections. This methodology is available on the Department's website.

## The baseline and 'with additional measures' scenarios

*Australia's emissions projections 2023* includes a baseline scenario and a 'with additional measures' scenario.

The baseline scenario includes federal and state and territory policies which have been implemented or where detailed design is well progressed. Since the 2022 emissions projections, a number of new policies have been incorporated including:

- the Safeguard Mechanism reforms and support provided under the Safeguard Transformation Stream of the Powering the Regions fund
- the announced pilot tenders under the CIS as per public announcements to August 30th, 2023
- the updated Victorian Renewable Energy target of 65% by 2030, and 95% by 2035
- the Household Energy Upgrades Fund announced at the 2023-24 Budget; and
- elements of the National Electric Vehicle Strategy, including the Fringe Benefits Tax exemption on EVs.

The 'with additional measures' scenario builds on the baseline, providing insights into the impact of policies that have been announced but where detailed design and consultation are ongoing. It includes the renewable electricity target of 82% by 2030 and further measures under the National Electric Vehicle Strategy, principally a fuel efficiency standard for light vehicles. Policies expected to help deliver the 82% renewable energy target include the expansion of the Capacity Investment Scheme to support 32 GW of capacity and renewable generation announced on 23 November 2023 and development of Renewable Energy Transformation Agreements with the States and Territories, endorsed by the Energy and Climate Change Ministerial Council on 24 November 2023.

The following stylised assumptions have been made about the policy settings to enable modelling for the purposes of these projections. The measures are subject to ongoing consultation, and these assumptions should not be interpreted as final policy design decisions.

- That the share of renewable energy increases to **82% of electricity generated in Australia's electricity grids** (National Electricity Market, Western Australia's Wholesale Electricity Market, the Darwin-Katherine Interconnected System, and the North-West Interconnected System) by 2030.
- The inclusion of **additional measures under the National Electric Vehicle Strategy,** including a fuel efficiency standard for light vehicles which is assumed to improve the average fuel efficiency of new cars sold in Australia over time, as outlined in the government's consultation paper published in April 2023.[1]

In addition, the 'with additional measures' scenario treats the voluntary cancellation of ACCUs under Climate Active as contributing to meeting Australia emissions reduction targets.[2]

A number of announced Commonwealth policies and measures were not included in the 'with additional measures' scenario as their emissions reduction impact is dependent on the outcome of grant rounds yet to be run or investment decisions yet to be made. These include Hydrogen Headstart, the National Reconstruction Fund and other streams of the Powering the Regions Fund (Industrial Transformation and Critical Inputs to Clean Energy Industries streams).

The Commonwealth, States and Territories are also considering or developing further policies to reduce emissions and seize the opportunities of a global net zero economy that are not considered in the scenarios. In particular, the Government is developing a new Net Zero 2050 plan with 6 sectoral plans to get there. The net zero plan will ensure Australia maximises the benefits of the global transition to net zero and provide long term policy certainty to drive investment in low emissions and renewable technologies.

A review has also commenced of carbon leakage measures, including the potential for an Australian Carbon Border Adjustment Mechanism. The Government is developing further measures to support key opportunities for Australia to become a renewable energy superpower—including in relation to renewable hydrogen, green metals, critical minerals processing, and manufacturing of generation and storage technologies including solar and batteries. Collaboration on energy and climate matters is also progressing through the Energy and Climate Change Ministerial Council. These measures are likely to impact Australia's emissions as they are finalised and implemented.

Appendix B provides further information on policies and measures included in these emissions projections.

[1] The Fuel Efficiency Standard – Cleaner, Cheaper to Run Cars for Australia

[2] The Government is consulting on this proposed treatment as outlined in the Climate Active Program Direction Consultation 2023. This treatment is consistent with onsite abatement, which counts towards the target, and reflects the end of Kyoto accounting arrangements.

# Australia's targets

As reflected in Australia's NDC under the Paris Agreement, Australia is committed to reduce emissions to 43% below 2005 levels by 2030 and net zero emissions by 2050.[3] These targets are also legislated under the *Climate Change Act 2022*.[4]

Australia's 2030 commitment is both a single year target to reduce emissions to 43% below 2005 levels by 2030, and a multi-year emissions budget from 2021-2030. Further details of Australia's emissions budget are at Appendix A.

The 2030 target is the next waypoint towards net zero by 2050. Parties to the Paris Agreement, including Australia, are required to communicate their NDC at least every five years, with each successive NDC reflecting their highest possible ambition. Australia will submit its next NDC by 2025.

# Tracking to the 2030 target

Under the baseline scenario, Australia's emissions are projected to be 386 Mt $CO_2$-e in 2030, or 37% below 2005 levels in 2030. Over the period 2021 to 2030, baseline emissions are 1% above Australia's 2021-2030 emissions budget.

Under the 'with additional measures' scenario, Australia's emissions are projected to be 358 Mt $CO_2$-e in 2030, or 42% below 2005 levels in 2030. Over the period 2021 to 2030, emissions are 1% under the emissions budget. That is, the 2030 target is met when assessed on a budget basis.

**Table 3 Tracking towards Australia's 2030 point target**

| | **Emissions in 2030, Mt $CO_2$-e** | **% below 2005** |
|---|---|---|
| 2030 Target | 351 | 43% |
| Baseline scenario | 386 | 37% |
| Voluntary cancellation of ACCUs[5] | 1 | |
| Emissions reduction task | 36 | |
| 'With additional measures' | 358 | 42% |
| Emissions reduction task | 7 | |

**Table 4 Tracking towards Australia's emissions budget target**

| | **Cumulative emissions 2021-2030, Mt $CO_2$-e** |
|---|---|
| 2021-2030 emissions budget | 4,353 |
| Baseline scenario | 4,384 |
| Voluntary cancellation of ACCUs[5] | 8 |
| Emissions reduction task | 39 |
| 'With additional measures' | 4,322 |
| Emissions reduction task | -32 |

[3] Australia's National Determined Contribution – Communication 2022

[4] *Climate Change Act 2022*

[5] When tracking towards the target in the baseline scenario, the emissions reduction task is adjusted for the voluntary cancellation of ACCUs projected to be 1 Mt $CO_2$-e in 2030 and 8 Mt $CO_2$-e from 2021-2030.

**Figure 2 Australia's emissions projections baseline and 'with additional measures' scenario tracking against the 2030 emissions point target, 1990 to 2035, Mt $CO_2$-e**

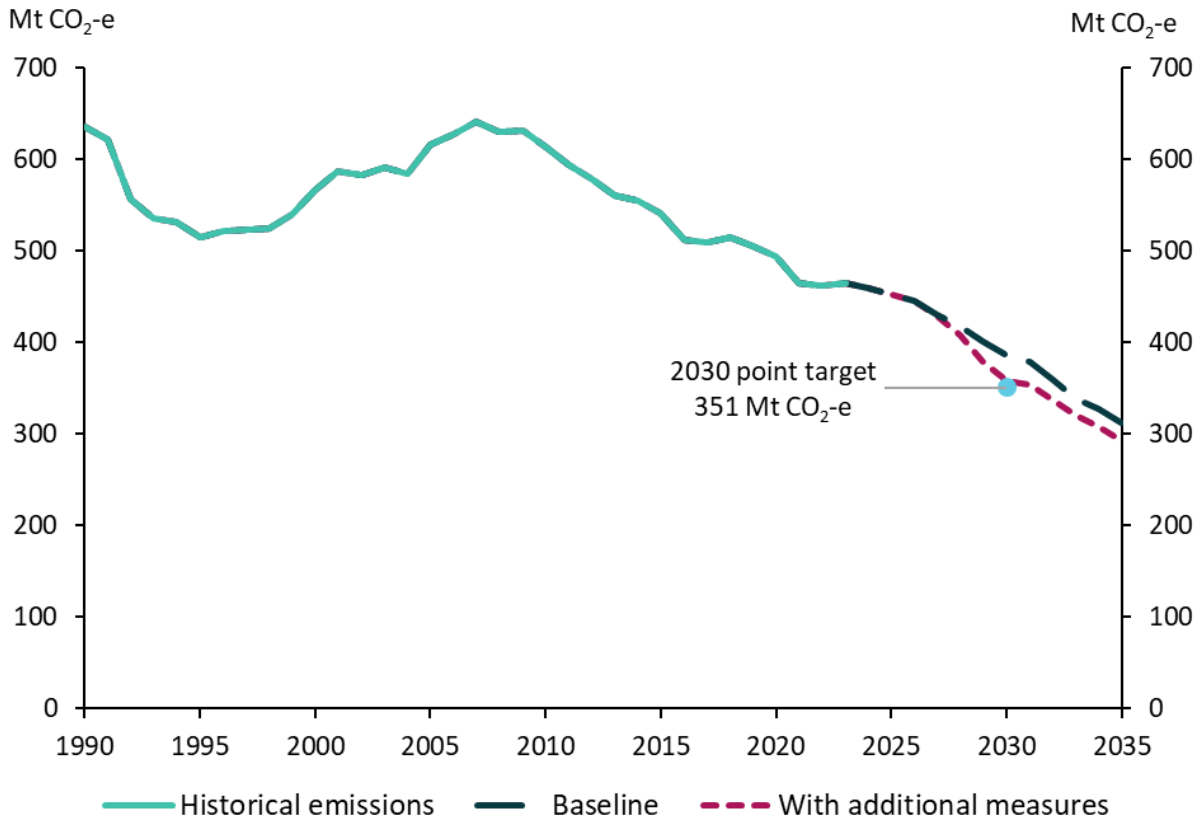
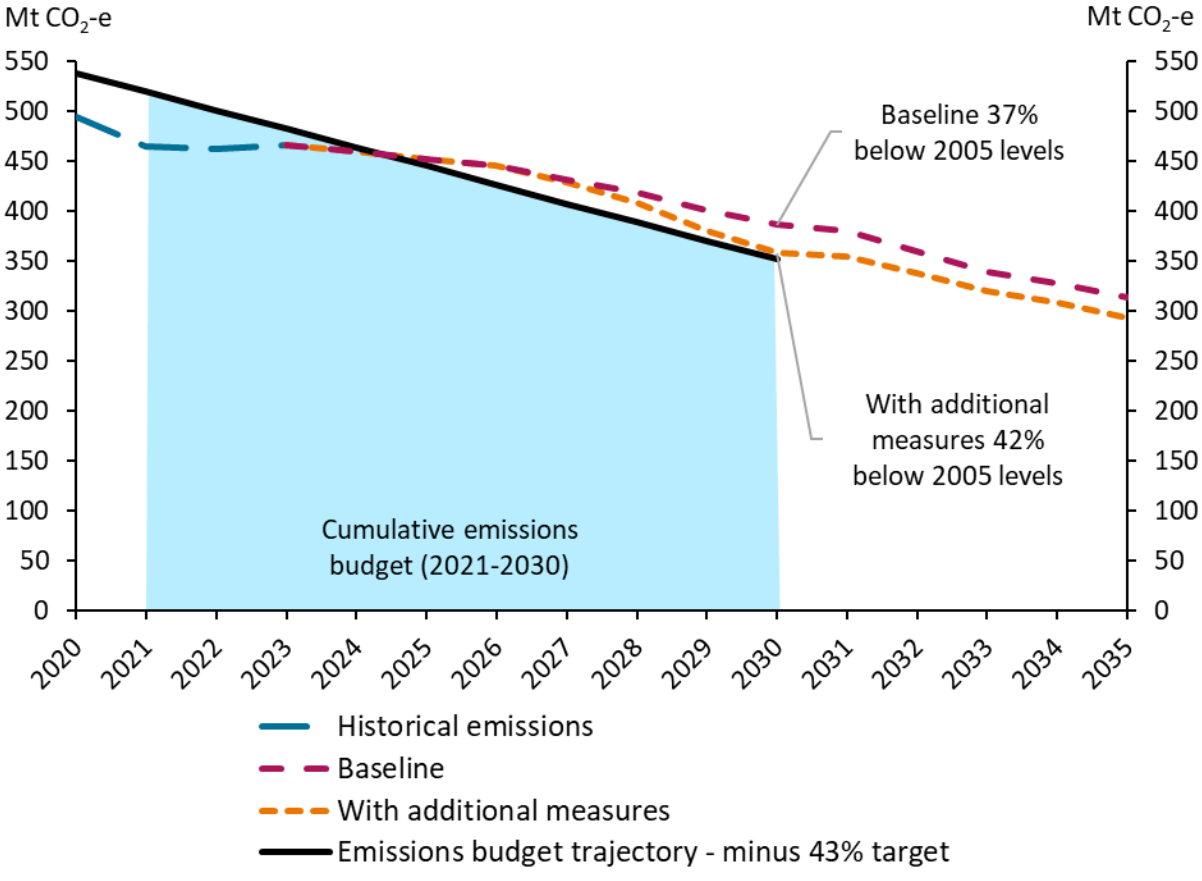


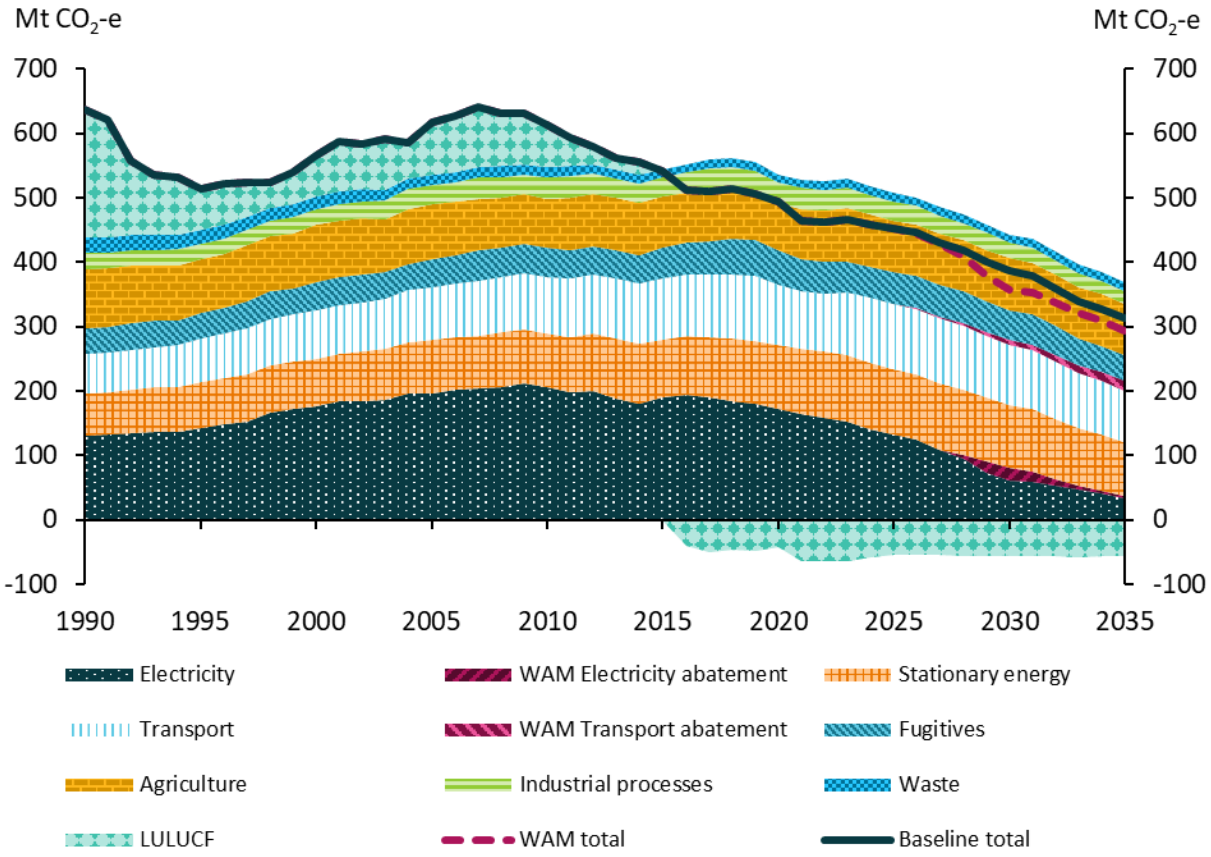

**Figure 3 Tracking against the 2030 emissions budget target, 2020 to 2035, Mt $CO_2$-e**



# Emissions trends

Under the baseline scenario, Australia's emissions are projected to decline from 465 Mt $CO_2$-e in 2023 to 386 Mt $CO_2$-e in 2030, which is 37% below 2005 levels, and to 313 Mt $CO_2$-e in 2035 which is 49% below 2005 levels. In the 'with additional measures' scenario, Australia's emissions are projected to decline from 465 Mt $CO_2$-e in 2023 to 358 Mt $CO_2$-e in 2030, which is 42% below 2005 levels, and 292 Mt $CO_2$-e in 2035, which is 53% below 2005 levels.

**Figure 4 Australia's emissions projections in the baseline and the 'with additional measures' (WAM) scenario, 1990 to 2035, Mt $CO_2$-e**




## The strongest emissions declines are projected in the electricity sector…

From 2023 to 2030, electricity emissions are projected to decline by nearly half (46%) due to the replacement of fossil fuel generation by renewables. This is driven by state and territory renewable energy targets and plans and is supported by Rewiring the Nation and the CIS. Electricity emissions continue to decline after 2030 supported by the Victorian Renewable Energy Target of 95% by 2035 and targets under the Queensland Energy and Jobs plan of 70% renewable energy by 2032 and 80% by 2035. Between 2023 and 2035, electricity emissions in the baseline decline by 85% in the National Electricity Market (NEM), and by 75% nationally, driven by post 2030 renewable targets in Victoria and Queensland.

## …with further reductions when the 82% renewable electricity target is included

In the 'with additional measures' scenario that includes the projected impact of the 82% renewable electricity target, electricity emissions are projected to decline by 60% from 2023 to be 60 Mt $CO_2$-e in 2030. Between 2023 and 2035, electricity emissions decline by 87% in the NEM, and by 79% nationally.

## Emissions reductions are projected for almost all other sectors too…

Under the baseline scenario, emissions are projected to decline to 2035 in the stationary energy, industrial processes and product use (IPPU) and the fugitive emissions from fuels (fugitives) sectors. This is largely in response to the Safeguard Mechanism reforms which incentivises Safeguard facilities to reduce emissions each year through investment in efficiency and technology improvements. The impact of the phase down of hydrofluorocarbon (HFC) imports also contributes to the decline in emissions in the IPPU sector.

Agriculture emissions in 2020 were at their lowest level since 1990 as a result of drought conditions. Emissions increased to 2023 reflecting particularly strong agricultural output following three consecutive La Niña events. However from 2023, agriculture emissions are projected to decline slightly from this peak and remain at roughly the same levels from 2030 to 2035, as seasonal conditions are assumed to return to the historical average.

Emissions in the waste sector are projected to decline from 2023 to 2030 due to improvements in waste diversion. After 2030, when the majority of ACCU scheme waste projects conclude, emissions increase marginally to 2035 as it is assumed that the abatement impact of these projects slowly declines over time without a sustained financial incentive to continue to invest in landfill gas capture.

The LULUCF sector is projected to remain a net sink to 2035. From a peak of -64 Mt $CO_2$-e in 2023, the net carbon sink is projected to decrease as the onset of the El Niño period reduces forest regrowth. The net sink in the land sector is then expected to remain relatively stable and be -56 Mt $CO_2$-e in 2035, due in large part to an overall reduction in native forest harvesting driven by policies in Western Australia and Victoria, continued lower rates of land clearing, and sequestration activities under the ACCU scheme.

**Figure 5 Change in the baseline and 'with additional measures' (WAM) scenario emissions from 2023 to 2030 by sector, Mt $CO_2$-e**

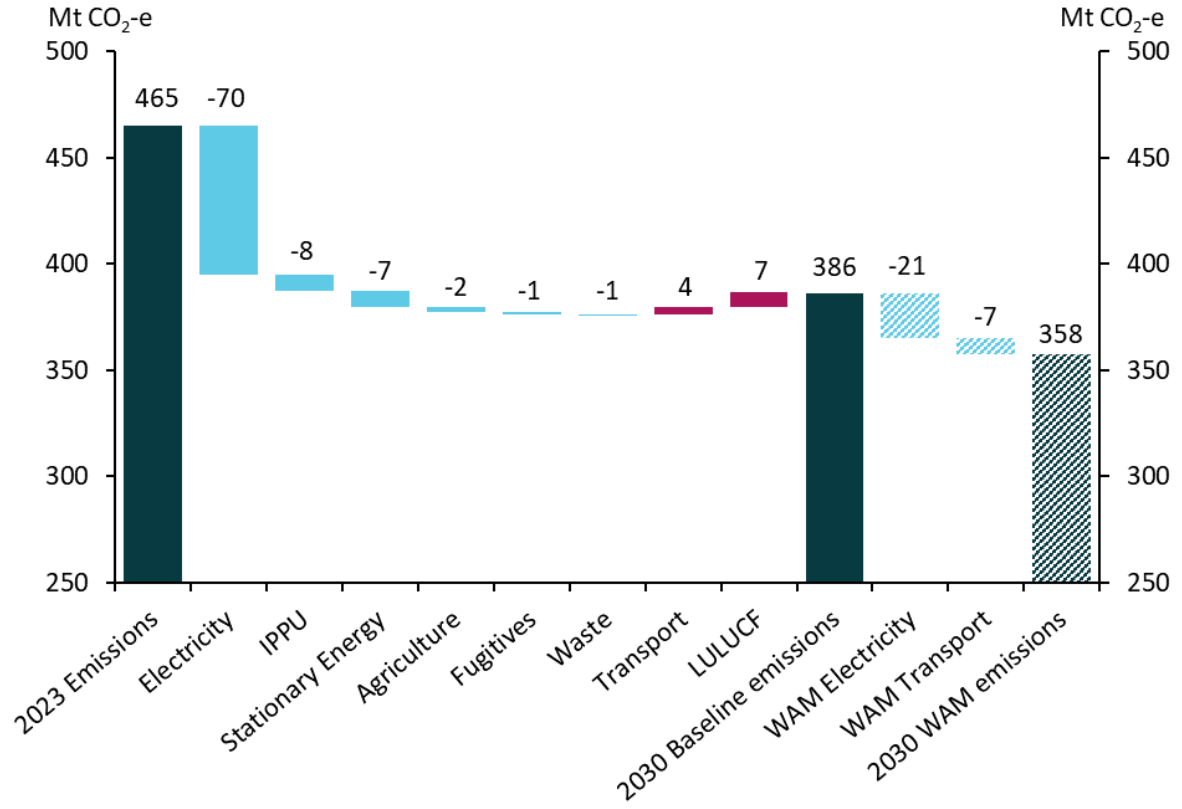
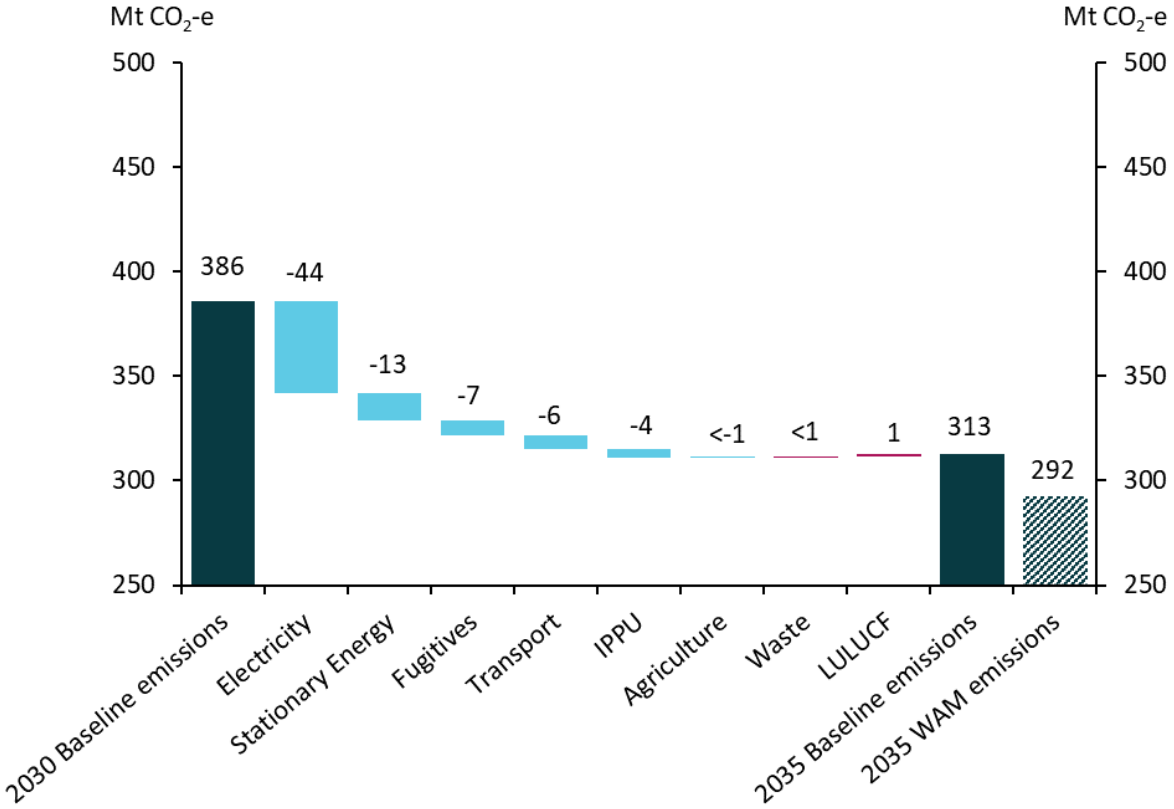



**Figure 6 Change in the baseline and 'with additional measures' (WAM) scenario emissions from 2030 to 2035 by sector, Mt $CO_2$-e**



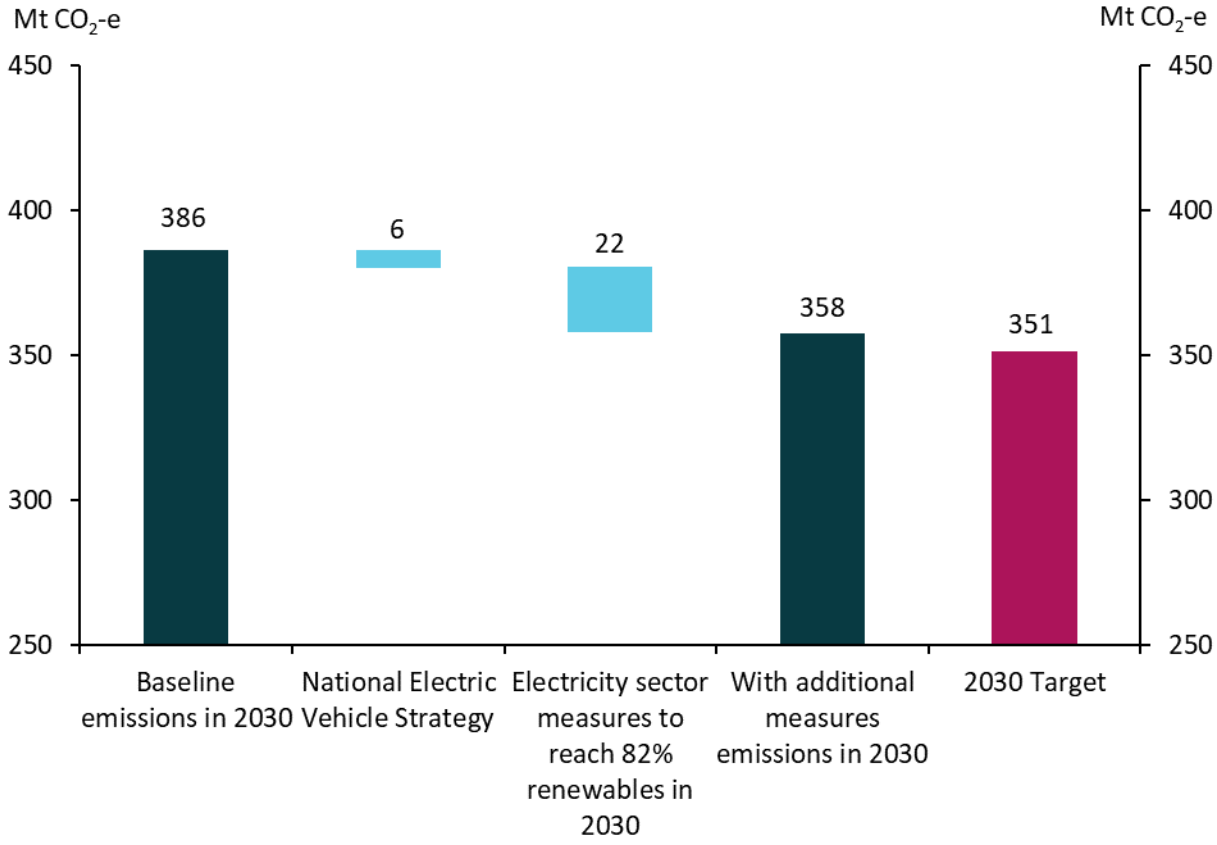
## …however emissions are projected to increase in the transport sector to 2030 in the baseline scenario

In the baseline scenario, transport emissions are projected to increase from 2023, returning to pre pandemic levels. While EV uptake is projected to grow as a proportion of new light vehicle sales to 2030 in the baseline scenario, there are increased emissions from trucks and aviation. From 2030 to 2035, transport emissions are projected to decline because of the growing impact of lower emissions vehicles.

## When further measures under the National Electric Vehicle Strategy are included, transport emissions decline

Under the 'with additional measures' scenario, which includes the impact of further measures under the National Electric Vehicle Strategy, principally a fuel efficiency standard for light vehicles, transport emissions are projected to decline from 2026 relative to the baseline. This reflects the projected increase in the number of EVs as well as more efficient hybrid and internal combustion engine (ICE) vehicles in the stock.

**Figure 7 Change in Australia's emissions from the baseline to the 'with additional measures' scenario in 2030 by policy, Mt $CO_2$-e**

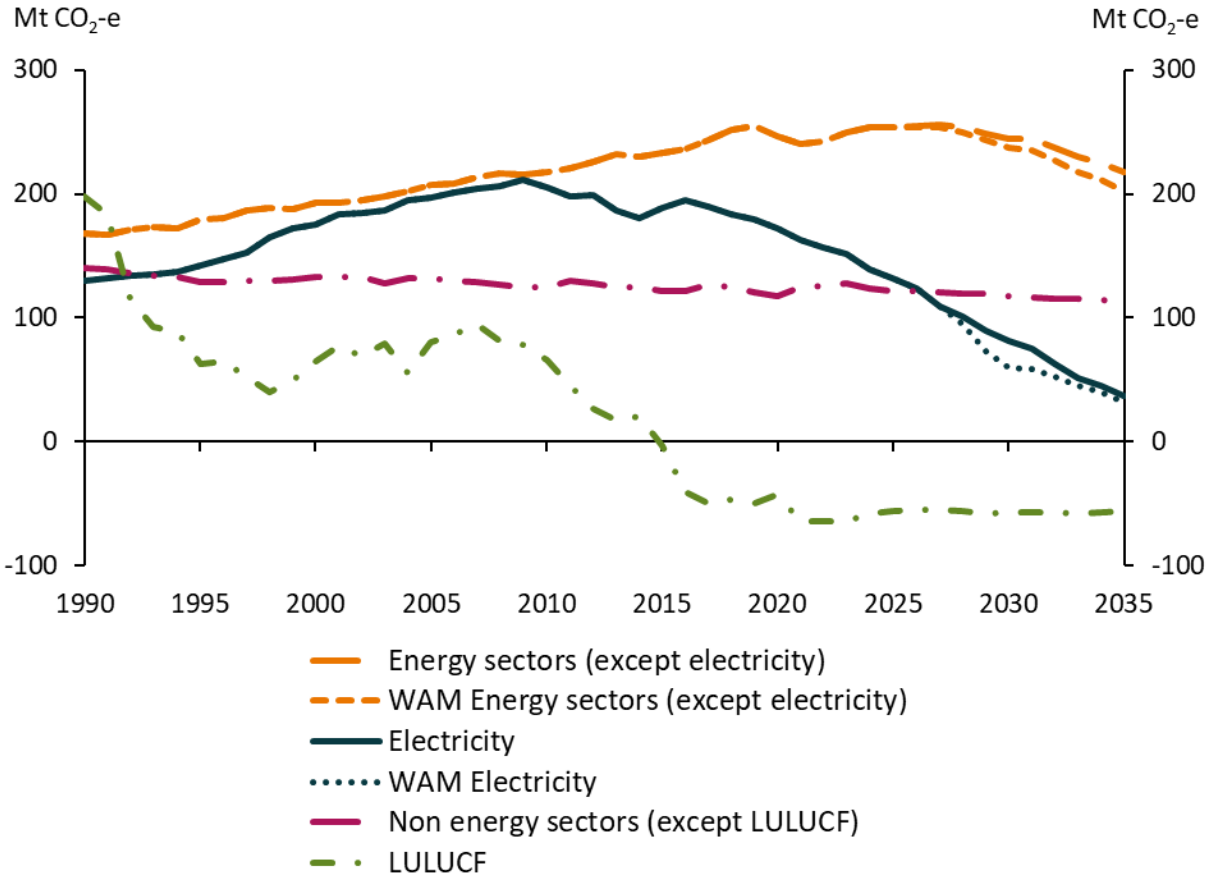



Note: This chart shows emissions reductions by policy. While the additional measures under the National Electric Vehicle Strategy, including a fuel efficiency standard, are expected to reduce transport emissions by 7 Mt $CO_2$-e, a small increase in electricity emissions is projected due to the increased uptake of EVs which in turn would increase electricity demand. As a result, the overall emissions reduction from additional measures under the National Electric Vehicle Strategy is slightly less than the reduction in the transport sector emissions shown in Figure 5.

## Achieving net zero emissions by 2050 is the long term goal

The 2023 emissions projections indicate Australia's emissions reduction policies will drive material progress towards the 2030 target. This progress, however, should be seen as part of continued efforts to get, and keep, Australia on a credible pathway to achieve net zero emissions by 2050. All sectors will need to contribute (Figure 8 and Figure 9). To give a sense of the further effort required, and assuming the 2030 target is met, Australia would need to reduce net emissions by 18 Mt $CO_2$-e a year on average to meet the 2050 target. To date, Australia has only achieved annual reductions of this magnitude in single years, not over a sustained period, and largely due to lower land clearing or increased sequestration.

**Figure 8 Baseline and 'with additional measures' (WAM) scenario emissions by electricity, LULUCF and all other sectors, 1990 to 2035, Mt $CO_2$-e**




Note: Energy sectors (except electricity) includes stationary energy, transport, and fugitives. Non energy sectors (except LULUCF) include agriculture, waste, and IPPU.

**Figure 9 Sector shares in the baseline and 'with additional measures' scenario in 2005, 2023 and 2030, % of Australia's emissions**

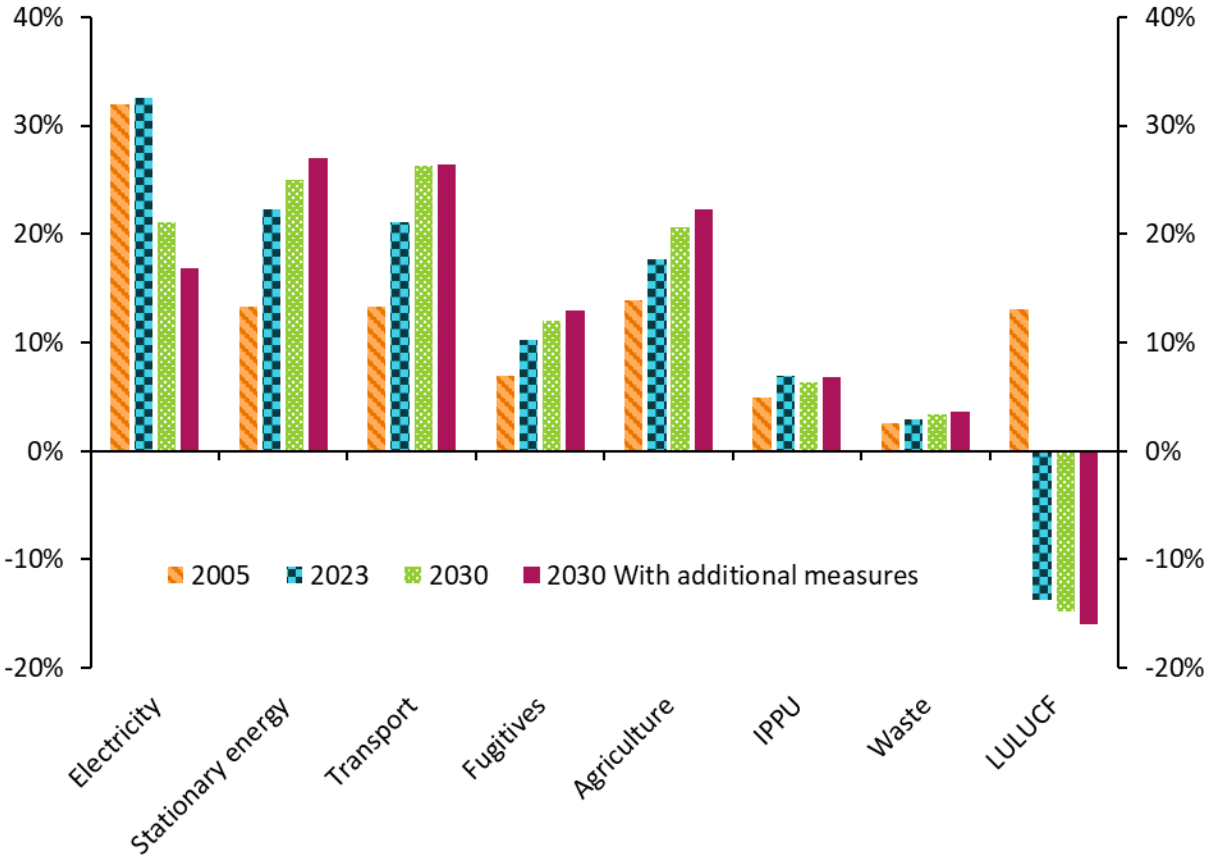



**Table 5 Emissions projections to 2035 in the baseline scenario, by sector, Mt $CO_2$-e**

| | National Greenhouse Gas Inventory | | Projection | | |
|---|---|---|---|---|---|
| **Sector** | **2005** | **2020** | **2025** | **2030** | **2035** |
| Electricity | 197 | 172 | 132 | 81 | 37 |
| Stationary energy | 82 | 100 | 102 | 96 | 83 |
| Transport | 82 | 93 | 102 | 102 | 95 |
| Fugitives | 43 | 54 | 50 | 46 | 39 |
| Agriculture | 86 | 73 | 79 | 80 | 80 |
| Industrial processes and product use | 30 | 32 | 30 | 25 | 21 |
| Waste | 16 | 13 | 13 | 13 | 13 |
| Land use, land-use change and forestry | 81 | -43 | -55 | -57 | -56 |
| **Total** | **616** | **494** | **452** | **386** | **313** |

Note: totals may not sum due to rounding

**Table 6 Emissions projections to 2035 in the 'with additional measures' scenario, by sector, Mt $CO_2$-e**

| | National Greenhouse Gas Inventory | | Projection | | |
|---|---|---|---|---|---|
| **Sector** | **2005** | **2020** | **2025** | **2030** | **2035** |
| Electricity | 197 | 172 | 132 | 60 | 32 |
| Stationary energy | 82 | 100 | 102 | 96 | 83 |
| Transport | 82 | 93 | 102 | 94 | 80 |
| Fugitives | 43 | 54 | 50 | 46 | 39 |
| Agriculture | 86 | 73 | 79 | 80 | 80 |
| Industrial processes and product use | 30 | 32 | 30 | 25 | 21 |
| Waste | 16 | 13 | 13 | 13 | 13 |
| Land use, land-use change and forestry | 81 | -43 | -55 | -57 | -56 |
| **Total** | **616** | **494** | **452** | **358** | **292** |

Note: totals may not sum due to rounding

# Other metrics

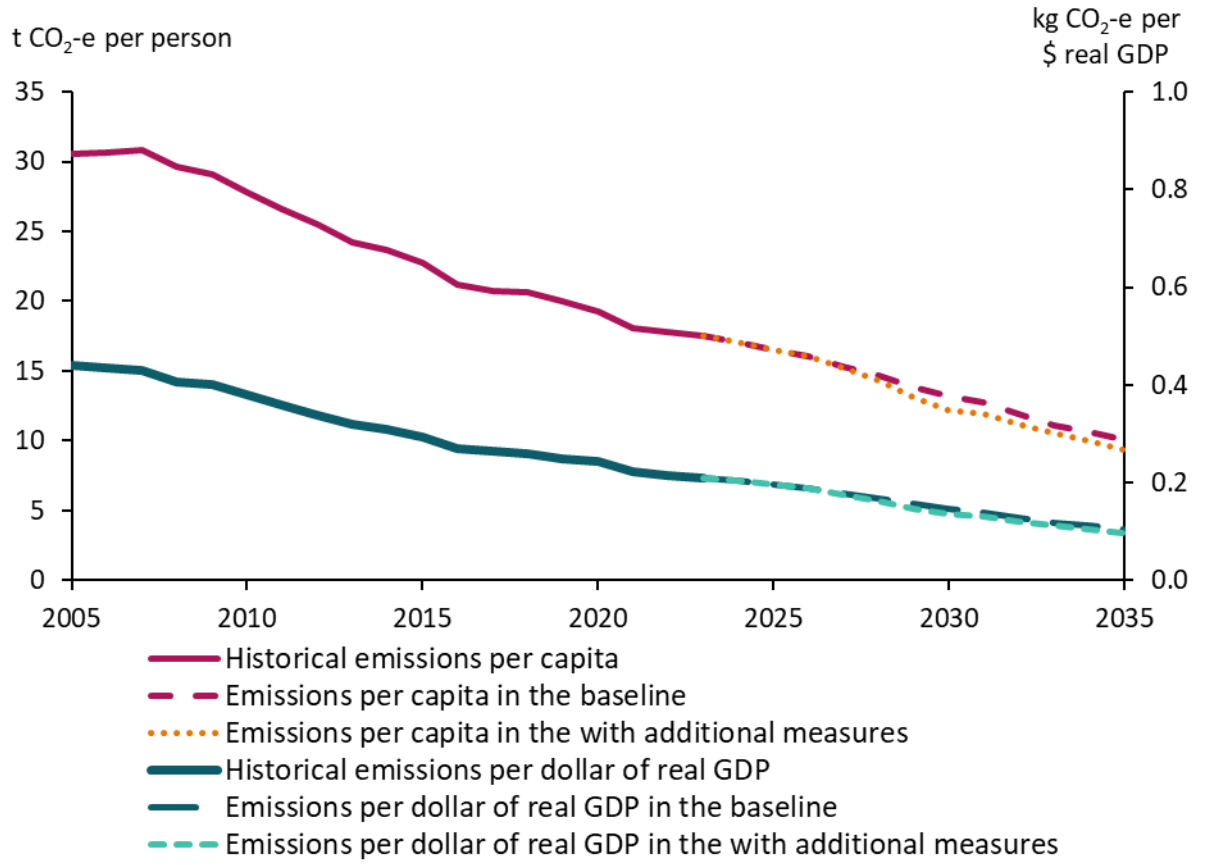
Metrics such as emissions per capita and emissions per unit of gross domestic product (GDP) provide additional insights into Australia's emissions trends over time.

Since 2005, Australia's emissions have fallen while the economy and population have grown. This trend of decoupling emissions from economic and population growth is projected to continue.

The emissions intensity of the economy is projected to fall by 67% between 2005 and 2030 in the baseline scenario and 69% in the 'with additional measures' scenario. Between 2005 and 2035, the emissions intensity of the economy is projected to fall by 76% in the baseline scenario and 78% in the 'with additional measures' scenario.

Emissions per person are projected to fall by 57% between 2005 and 2030 in the baseline scenario and 60% in the 'with additional measures' scenario. Between 2005 and 2035, emissions per person are expected to fall further by 67% in the baseline scenario and 69% in the 'with additional measures' scenario.

**Figure 10 Australia's projected emissions per person and the projected emissions intensity of the economy,[6] 2005 to 2035**




# Changes since the 2022 emissions projections

The emissions projections have been updated to include more recent economic and activity data, updated forecasts of domestic and global demand for Australian energy, resources and agricultural products as well as the latest information on technology costs, uptake and deployment.

Projected emissions in the baseline scenario in 2030 have fallen from 422 Mt $CO_2$-e in the 2022 emissions projections to 386 Mt $CO_2$-e in the 2023 emissions projections. Tracking towards the target has also improved from 32% to 37% below 2005 levels in 2030.

New and updated federal, state and territory policies have been included in the baseline emissions projections. The reforms to the Safeguard Mechanism, which was included in the 'with additional measures' scenario of the 2022 projections, are now included in the 2023 baseline following passage of the enabling legislation through the Australian Parliament in March 2023 and amendment of the subordinate legislation in May 2023. The reforms commenced operation on 1 July 2023.

[6] Emissions per dollar of real GDP, reference year 2020-21.

**Table 7 Comparison between 2022 and 2023 baseline emissions projections in 2030, by sector, Mt $CO_2$-e**

| Sector | 2022 baseline emissions projections | 2023 baseline emissions projections | Difference |
|---|---|---|---|
| Electricity | 79 | 81 | 2 |
| Stationary energy | 101 | 96 | -5 |
| Transport | 103 | 102 | -1 |
| Fugitives | 55 | 46 | -9 |
| Agriculture | 79 | 80 | 1 |
| Industrial processes and product use | 28 | 25 | -3 |
| Waste | 11 | 13 | 2 |
| Land use, land use change and forestry | -33 | -57 | -24 |
| **Total** | **422** | **386** | **-36** |

Note: totals may not sum due to rounding

Projected baseline emissions from the stationary energy, fugitives and IPPU sectors are lower compared with the 2022 emissions projections driven by the impact of the reforms to the Safeguard Mechanism. The LULUCF sink is also projected to be larger in 2030. This reflects updates and method improvements in the most recent National Inventory Report and increased market demand for ACCUs driving eligible emission reduction activities, such as reforestation and savanna burning management.

Somewhat offsetting this decline, projected baseline emissions from the electricity sector are higher compared with the 2022 emissions projections - due to increased electricity demand resulting from electrification driven by the Safeguard Mechanism reforms and the elements of the National Electric Vehicle Strategy included in the baseline scenario. Waste emissions are also higher compared to previous projections, reflecting updated advice on progress towards federal, state and territory food waste, recovery and diversion targets as well as advice on methane capture under the ACCU Scheme.

**Table 8 Comparison between 2022 and 2023 'with additional measures' emissions projections in 2030, by sector, Mt $CO_2$-e**

| Sector | 2022 emissions projections | 2023 emissions projections | Difference |
|---|---|---|---|
| Electricity | 62 | 60 | -2 |
| All other sectors[7] | 307 | 297 | -9 |
| **Total** | **368** | **358** | **-11** |

Note: totals may not sum due to rounding

Projected emissions in the 'with additional measures' scenario in 2030 have fallen from 368 Mt $CO_2$-e in the 2022 emissions projections to 358 Mt $CO_2$-e in the 2023 emissions projections. In the 'with additional measures' scenario, tracking towards the target improved from 40% to 42% below 2005 levels in 2030.

In addition to the economic, activity and technology updates described for the baseline scenario, the 'with additional measures' scenario has been updated to include further measures under the National Electric Vehicle Strategy, including a fuel efficiency standard for light vehicles.

[7] In the 2022 emissions projections, the emission results for the 'with additional measures' scenario were presented for the 'electricity' and 'all other' sectors, given the method used for estimating the impact of the Safeguard Mechanism reforms. It has been presented here to enable comparison with the 2023 emissions projections results.

# Cross cutting policies

This section outlines the emissions impact of policies that target multiple sectors of the economy: the Safeguard Mechanism reforms, which are included in the baseline scenario for the first time; and the ACCU Scheme.

## The Safeguard Mechanism

The Safeguard Mechanism provides a legislated framework that limits the net emissions ('baselines') of large industrial facilities. The Safeguard Mechanism applies to facilities emitting more than 100,000 t $CO_2$-e each year, including in mining, oil and gas production, manufacturing, transport and waste.

The Government's reforms to the Safeguard Mechanism require these large industrial facilities to reduce their net emissions. Facilities are able to meet their Safeguard obligations through a combination of on-site emission reductions at the facility, for example through efficiency improvements or technology upgrades, and through the surrender of ACCUs or Safeguard Mechanism Credits (SMCs).[8] These reforms commenced on 1 July 2023.

**Box 1 Safeguard Mechanism reforms – baselines and targets**

*Safeguard baselines*

Safeguard baselines will decline by 4.9 per cent each year to 2030. Safeguard baselines are set based on a production-adjusted (emissions intensity) framework. After 2030, decline rates will be set in five-year blocks, on a trajectory to net-zero by 2050. An indicative decline rate from 2030 has been included in the Safeguard Rule.[9]

Baselines for existing facilities will be set using a hybrid model initially weighted towards the use of site-specific emissions intensity values, transitioning to industry average emissions intensity values by 2030.

All new facilities will be given baselines set at international best practice levels, adapted for an Australian context. The baseline for reservoir $CO_2$ emissions of new gas fields supplying existing liquefied natural gas facilities is zero. Shale gas projects, including those in the Beetaloo Basin, must have net-zero scope 1 emissions from the outset.

Facilities that fall below the coverage threshold of 100,000 t $CO_2$-e can choose to continue to receive SMCs for up to 10 years, noting that their baseline will continue to decline if they opt-in.

*Safeguard targets*

The reforms require large industrial facilities to deliver a proportional share of Australia's 2030 climate targets. To achieve this, net emissions from all Safeguard facilities should not exceed 100 Mt $CO_2$-e in 2029-30, 1,233 million tonnes over the decade from 1 July 2020 to 30 June 2030, and zero from 2049-50.

There is also a requirement for gross emissions from all Safeguard facilities to reduce over time, measured on a 5-year rolling average basis. From 1 July 2024, the rolling average of Safeguard-covered emissions over the previous 5-years is required to be lower than the 5-year rolling average from three years earlier. From 1 July 2027, the 5-year rolling average of Safeguard-covered emissions is required to be lower than the 5-year rolling average from two years earlier.

[8] Facilities generate tradeable SMCs when their emissions are below their Safeguard baseline.

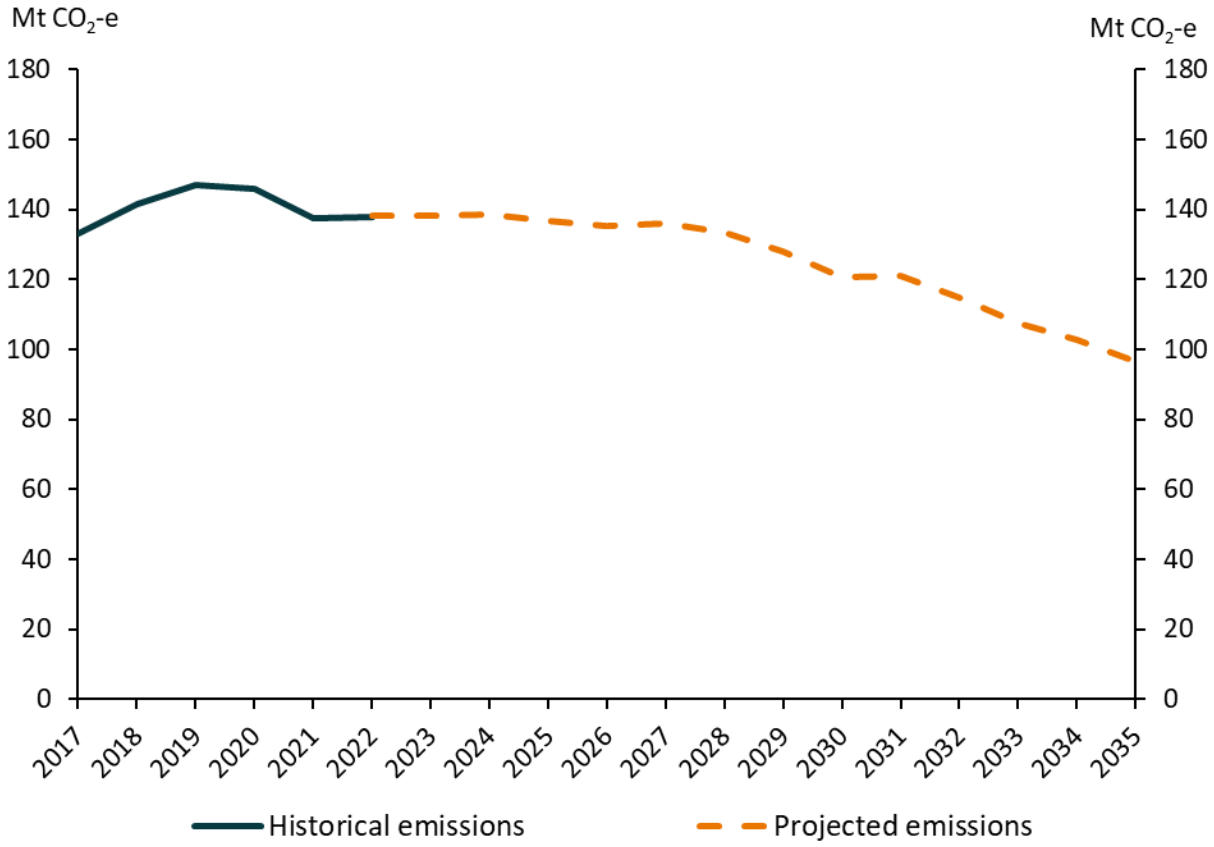
[9] After 2030, baselines decline by the indicative annual decline rate of 3.285 per cent.

## Gross (on-site) emissions

In 2022, there were around 219 Safeguard facilities across the mining, manufacturing, transport, oil, gas and waste sectors. The gross emissions[10] of these facilities were 138 Mt $CO_2$-e in 2022.

The gross emissions of Safeguard facilities are projected to decline by 13% from 138 Mt $CO_2$-e in 2022[11] to 121 Mt $CO_2$-e in 2030 and further decline by 20% to 97 Mt $CO_2$-e between 2030 and 2035. Emissions follow a downward trend with the exception of 2031, when yearly emissions are projected to increase marginally due to higher liquified natural gas (LNG) production in that year. Figure 11 shows gross emissions from Safeguard facilities from 2017 to 2035.

**Figure 11 Aggregate Safeguard facilities gross (on-site) emissions, 2017-2035, Mt $CO_2$-e[12]**




[10] Gross emissions are defined as on-site emissions occurring at Safeguard facilities as reported to the Clean Energy Regulator (CER) under the National Greenhouse and Energy Reporting (NGER) Scheme.

[11] 2022 is the latest data published by the CER.

[12] The historical Safeguard emissions data (2017-2022) is sourced from information reported to the CER under the NGER Scheme. Historical emissions in 2017-2020 have been adjusted to reflect the 100-year global warming potential values from the IPCC Fifth Assessment Report (AR5) to ensure time-series consistency. Therefore these values may differ from Safeguard facility reported emissions published by the CER.

## On-site emissions reductions

Safeguard facilities are projected to achieve 23 Mt $CO_2$-e of on-site annual emissions reductions in 2030 and 46 Mt $CO_2$-e in 2035 relative to Safeguard 'business as usual' emissions. Facilities are assumed to progressively implement on-site emissions reductions, initially prioritising low-cost process improvements and small equipment upgrades, where available, before gradually investing in larger-scale projects. Emissions reduction technology projects are outlined in the subsequent sectoral chapters of the report and include efficiency improvements, electrification and carbon capture and storage (CCS). Decisions to implement emissions reduction projects are driven by a number of factors including the suitability of a technology at a particular site, the age and remaining lifespan of the facility, the emissions intensity of the facility, and the relative economics of on-site emissions reduction and the price of ACCUs and SMCs.

Figure 12 shows the largest share of the on-site emissions reductions by sector is from stationary energy, followed by the fugitives and IPPU sectors. Presenting on-site emissions reductions by economic sector (the Australia-New Zealand Standard Industry classifications (ANZSIC)) allows for comparison of more widely understood and familiar sectors. Figure 13 shows that the largest share of on-site emissions reductions (e.g. 62% in 2030) are in the economic (ANZSIC) sectors of mining, including coal mining, oil and gas extraction, metal ore mining and non-metallic mineral mining.

**Figure 12 Safeguard on-site emissions reduction by sector, 2024-2035, Mt $CO_2$-e**

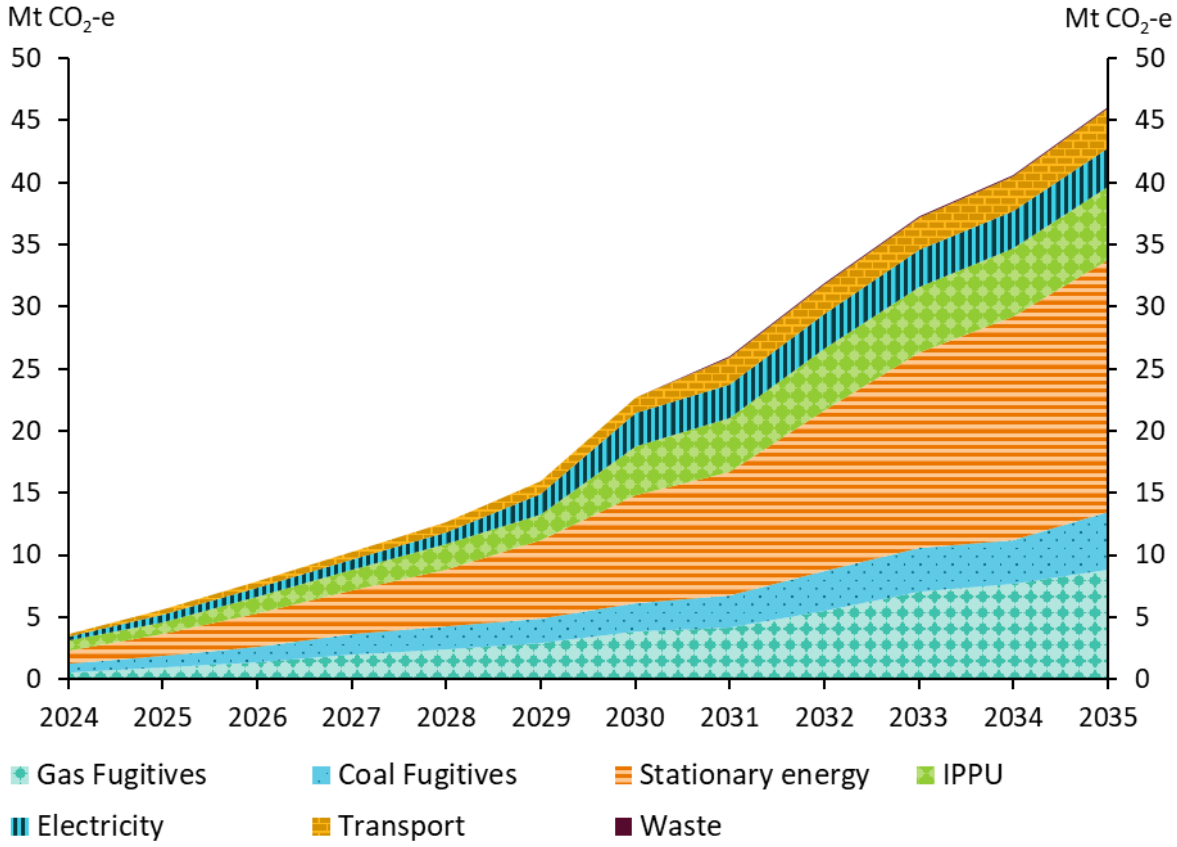
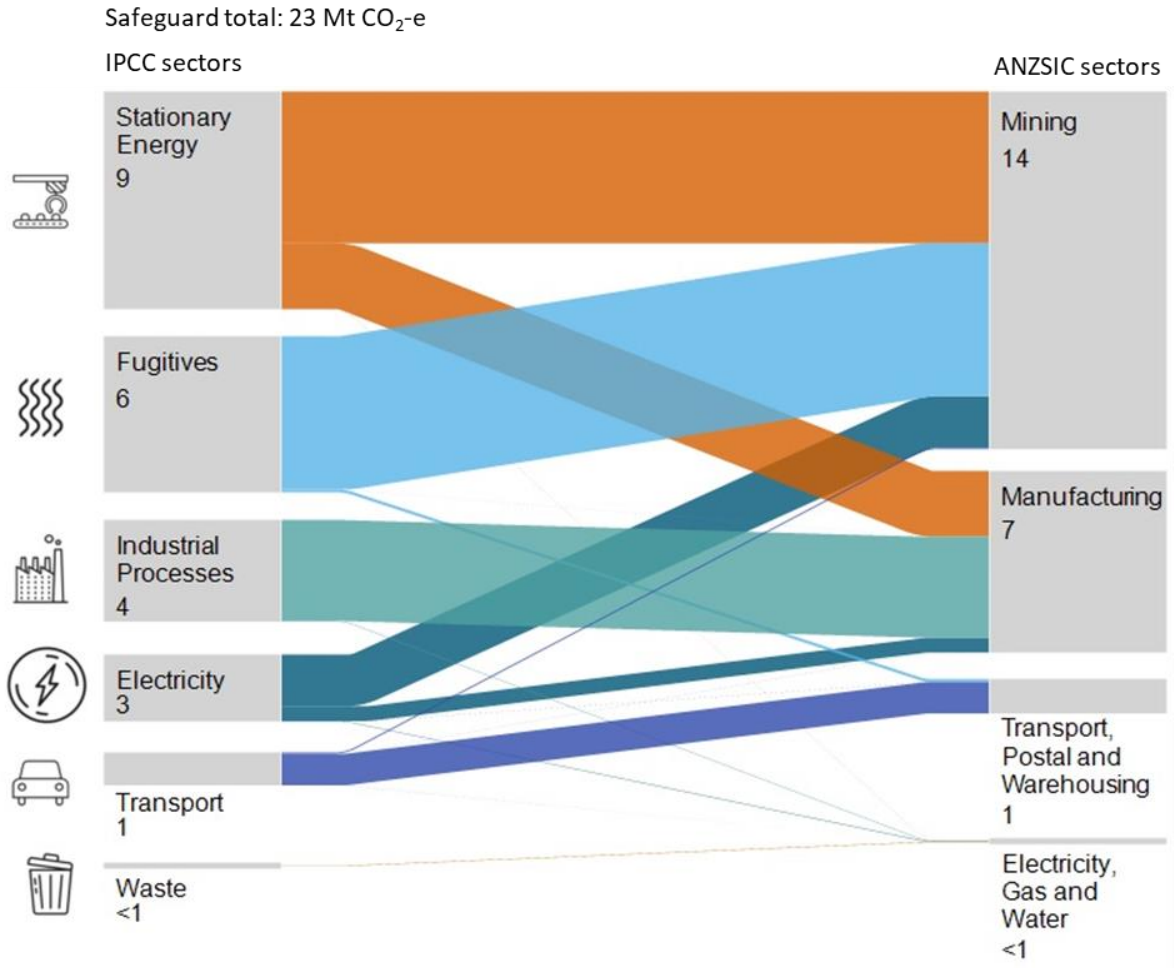


**Figure 13 On-site Safeguard emissions reductions by Intergovernmental Panel on Climate Change (IPCC) and economic sector in the baseline scenario, 2030, Mt $CO_2$-e**




Note: totals may not sum due to rounding.

## Demand for units by Safeguard facilities

As part of the Safeguard Mechanism's compliance arrangements, facilities can surrender ACCUs and SMCs to meet their net emissions[13] compliance obligations. SMCs are generated when a facility's on-site emissions are below their baseline. Safeguard facilities can surrender SMCs to meet their own Safeguard compliance obligations or sell the SMCs to other Safeguard facilities. Safeguard facilities are projected to generate 6 million SMCs in 2030 and 5 million SMCs in 2035 (Figure 14).

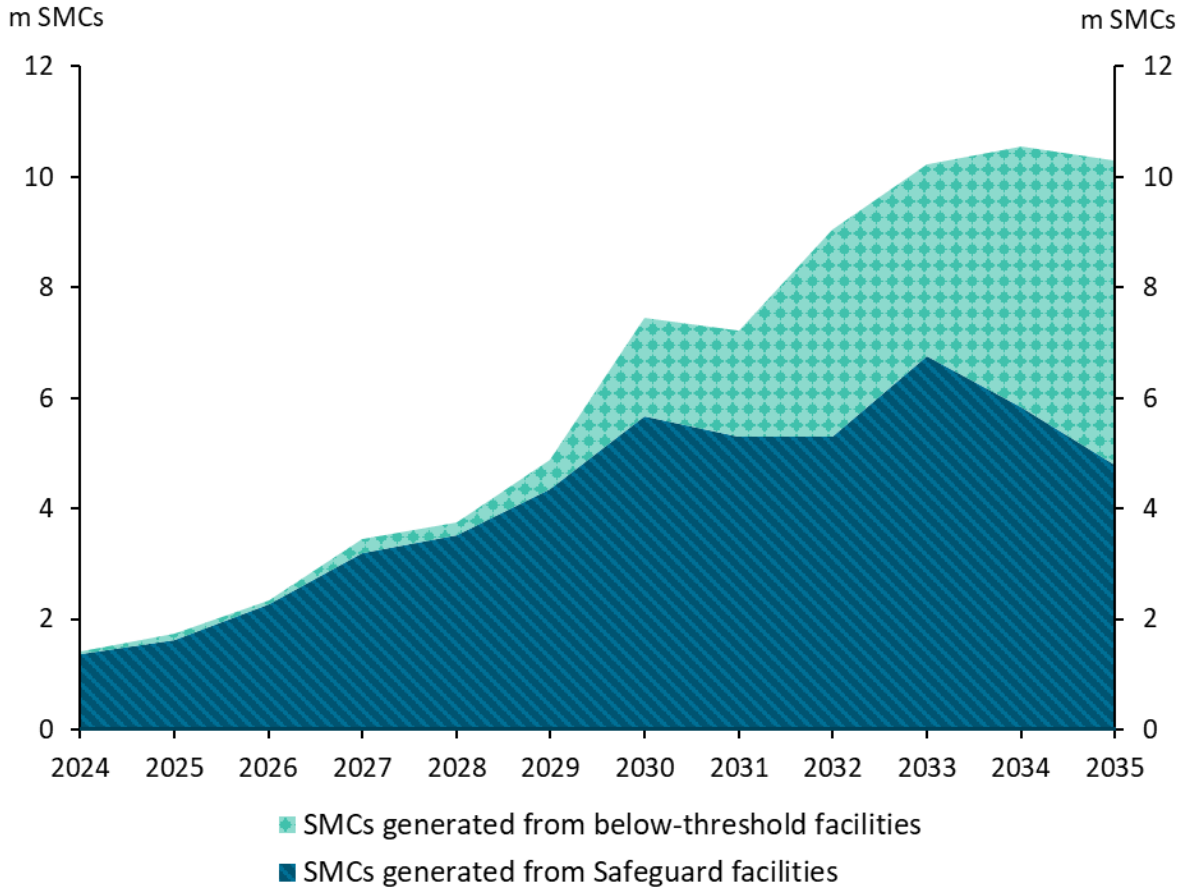
In addition to the use of SMCs generated by Safeguard facilities, it is projected that there will be additional net demand for units to meet compliance obligations. Net demand for units[14] is projected to be 27 million units in 2030 and 28 million units in 2035. These units are predominantly ACCUs. In addition, former Safeguard facilities that have fallen under the 100,000 t $CO_2$-e threshold are projected to generate 2 million SMCs in 2030 and 6 million SMCs in 2035 (Figure 14). By 2035, most

[13] Net emissions are gross emissions less units (ACCUs and SMCs) surrendered and are equivalent to Safeguard baselines.

[14] Net demand for units are met by ACCUs and SMCs generated by former Safeguard facilities that have fallen under the 100,000 t $CO_2$-e threshold.

SMCs from below threshold facilities are projected to be generated from a small number of aluminium smelters and alumina refineries. These facilities are projected to invest in new technologies such as replacing carbon anodes in aluminium smelters with inert anodes, electrification of process heat, switching from coal to gas-fired boilers, and the uptake of the Mechanical Vapour Recompression (MVR) technology, causing emissions to decline below 100,000 t $CO_2$-e per year, well below their baseline.

**Figure 14 Projected SMC generation 2024-2035, million SMCs**



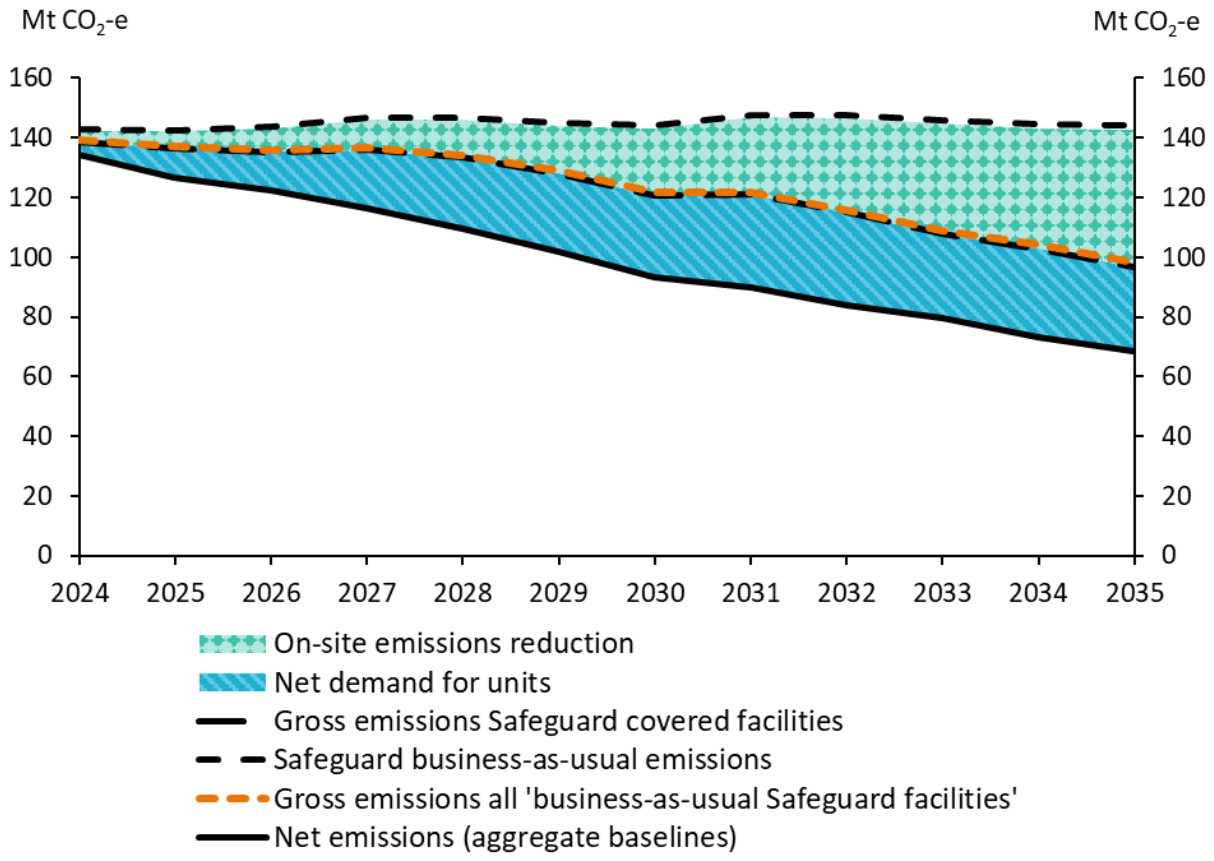

Net emissions from Safeguard facilities are projected to be 93 Mt $CO_2$-e in 2030, which is below the legislated target of 100 Mt $CO_2$-e. Aggregate net emissions over the decade from 2021 to 2030 are projected to be 1,217 Mt $CO_2$-e, which is below the legislated target of 1,233 million tonnes. Net emissions reflect a combination of on-site abatement and net demand for units as outlined in Figure 15 and Table 9.

**Table 9 Safeguard emissions, on-site emission reductions and net demand for units, Mt $CO_2$-e**

| | 2024 | 2030 | 2035 | 2024-2030 | 2024-2035 |
|---|---|---|---|---|---|
| **Safeguard business-as-usual emissions[15]** | **143** | **144** | **144** | **1,011** | **1,741** |
| On-site emission reductions | -4 | -23 | -46 | -78 | -259 |
| **Gross emissions all 'business-as-usual Safeguard facilities'[16]** | **139** | **122** | **98** | **933** | **1,482** |
| **Gross emissions Safeguard-covered facilities[17]** | **138** | **121** | **97** | **928** | **1,471** |
| Net demand for units | -4 | -27 | -28 | -124 | -272 |
| **Net emissions (Safeguard aggregate baselines)** | **134** | **93** | **68** | **804** | **1,199** |

Note: totals may not sum due to rounding

**Figure 15 Safeguard business-as-usual, gross emissions, on-site emissions reductions and net demand for units 2024-2035, Mt $CO_2$-e**




[15] Business as usual emissions in the absence of the Safeguard reforms are estimated by holding the emissions intensity of production fixed at current levels.

[16] 'Gross emissions at all 'business-as-usual Safeguard facilities'' are the aggregate onsite emissions of all facilities that were expected to be above the 100,000 tonnes $CO_2$-e threshold before the Safeguard reforms were implemented and onsite emissions reductions occurred. That is, it includes facilities whose emissions were above 100,000 t $CO_2$-e but then fall under 100,000 t $CO_2$-e after undertaking onsite emissions reductions.

[17] 'Gross emissions at Safeguard-covered facilities' are aggregate onsite emissions of Safeguard facilities that remain above the 100,000 tonnes $CO_2$-e threshold after onsite emissions reductions.

# The Australian Carbon Credit Units Scheme

The ACCU Scheme offers landholders, communities, and businesses the opportunity to run projects in Australia that avoid the release of emissions or remove and sequester carbon from the atmosphere. Each ACCU represents one tonne of carbon dioxide equivalent (t $CO_2$-e) stored or avoided by a project. ACCUs can be sold to the Government under Carbon Abatement Contracts, used to meet obligations under the Safeguard Mechanism, voluntarily retired under the Climate Active program or used for other purposes.

ACCU projects can reduce emissions or sequester carbon from a range of activities. To date, however, the majority of projects have been undertaken in the LULUCF sector to increase sequestration or reduce emissions (including from vegetation and savanna fire management projects) and in the waste sector.

As with other products in the economy, ACCU supply and demand are influenced by prices. These projections draw on the best available information to estimate the demand for ACCUs given alternative emission reduction opportunities, in particular on-site abatement actions at Safeguard facilities, taking account of changes in the cost of abatement and technology availability over time. Additional supply of ACCUs is projected to become available as prices increase, taking account of the time required for projects to proceed and for abatement to occur.

## ACCU demand and issuance

ACCU demand[18] is projected to increase, peaking in 2031 (Figure 16). The primary source of increased demand is the Safeguard Mechanism where, in addition to on-site abatement and SMCs, companies are projected to use ACCUs to meet their obligations. Demand from the Safeguard Mechanism is expected to increase from less than 1 million ACCUs in 2022 to 26 million ACCUs in 2030. After 2031, ACCU demand is projected to decline as more on-site abatement opportunities are taken up to meet Safeguard obligations. Deliveries of ACCUs under Government carbon abatement contracts and voluntary cancellation of ACCUs are projected to be smaller sources of demand.

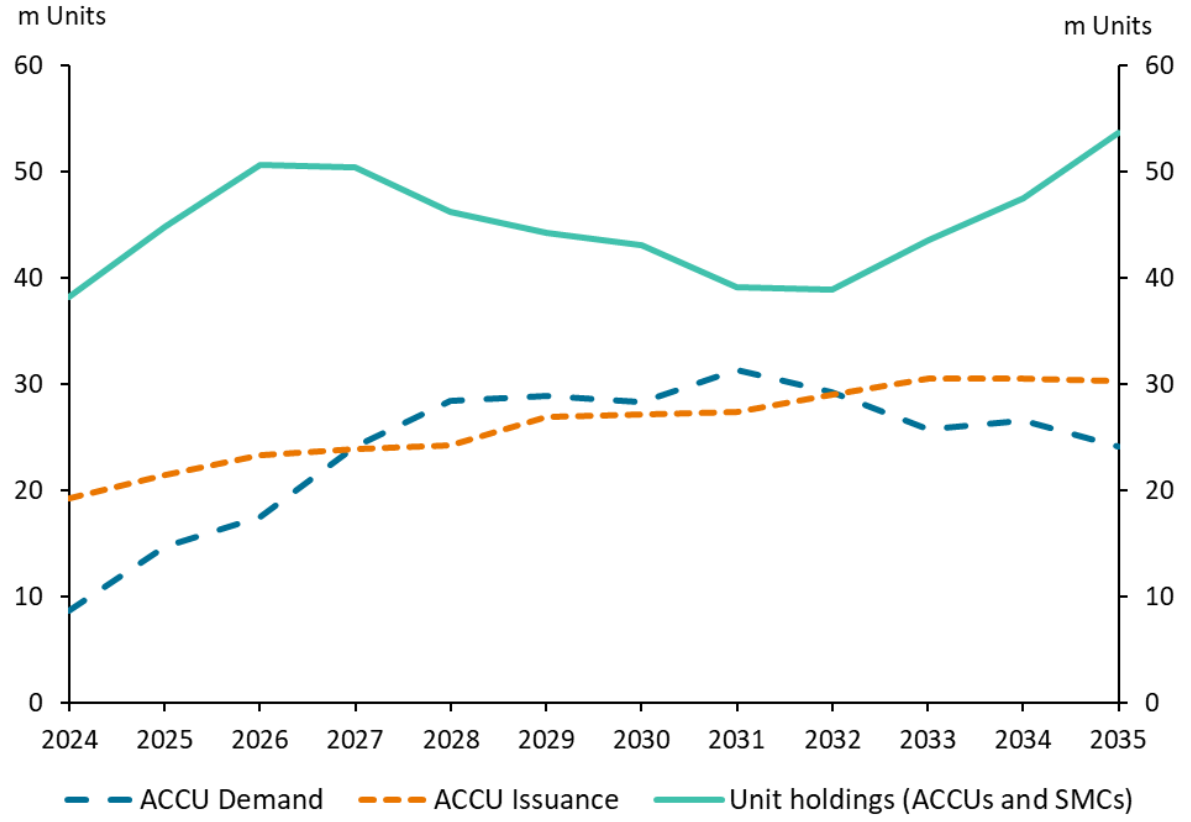
The annual issuance of ACCUs is projected to grow steadily from 16-17 million ACCUs in 2023 to 30 million ACCUs by 2033. Increased ACCU issuance will be incentivised by higher ACCU prices (see Box 2). Currently, the majority of ACCUs are generated from the land sector. This is projected to continue, with the largest sources of new ACCU issuance coming from vegetation, and savanna fire management.

Unit holdings in the Australian National Registry of Emissions Units were 27.6 million at the end of the 2023 financial year.[19] ACCU issuance is currently greater than demand and this is projected to continue to 2027, increasing the holdings of units. After 2027, demand is expected to temporarily overtake new issuance, however this will be met by use of existing ACCU holdings (Figure 16).

[18] ACCU demand is defined as cancellation of ACCUs to meet obligations under the Safeguard Mechanism, delivery of ACCUs to the Commonwealth against carbon abatement contracts and the voluntary cancellation of ACCUs.

[19] Quarterly Carbon Market Report June Quarter 2023, Clean Energy Regulator

**Figure 16 Projected ACCU Issuance, Demand and Unit Holdings, 2024 to 2035, million units**



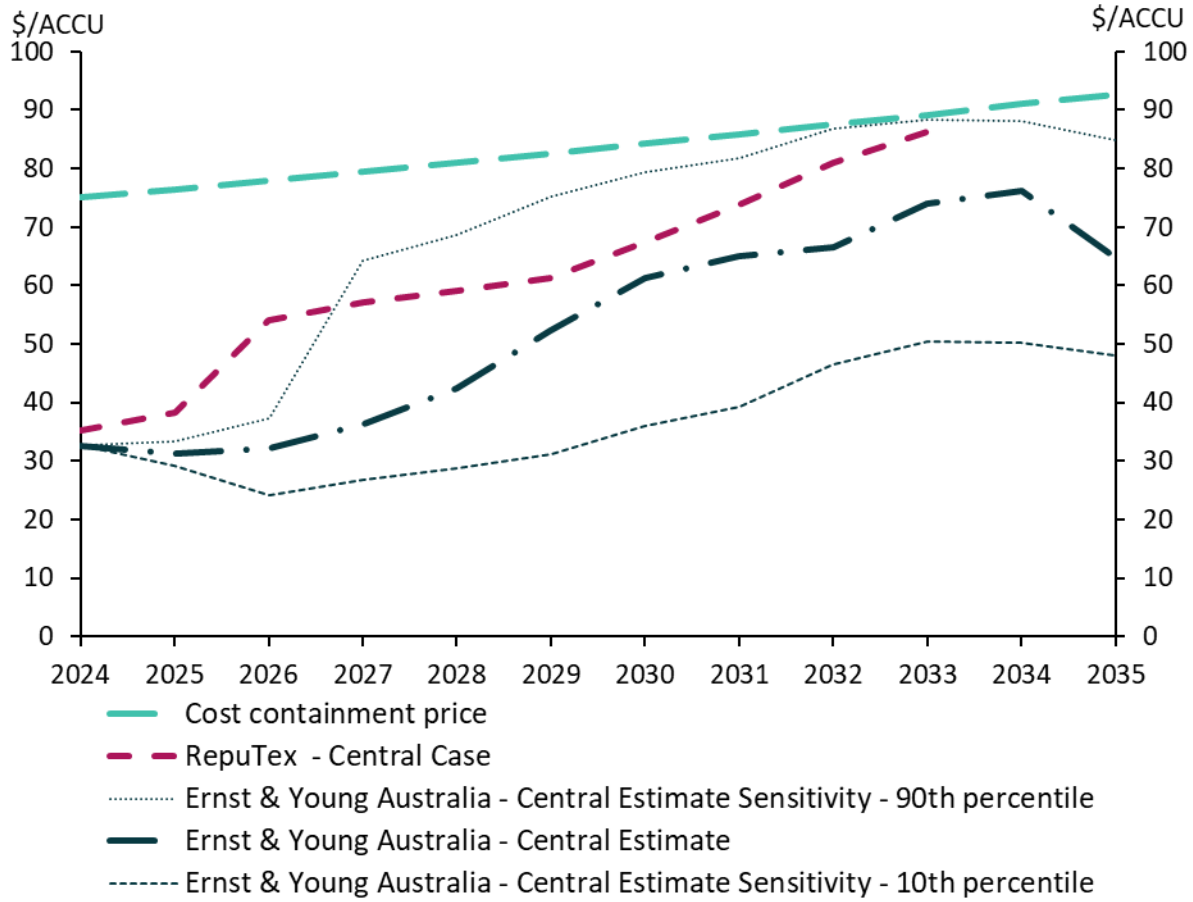

## Box 2 Forecast ACCU Prices

Several market analysts model expectations of future ACCU prices. Central scenario estimates from Ernst & Young Australia (EY) and RepuTex are presented in Figure 17. These forecasts see prices increasing to $60 per ACCU (real $A 2023-24) or more by 2030 but remaining below the Safeguard cost containment price[20] over the forecast period.

ACCU demand and price forecasts are considered highly uncertain given the market transition associated with the Safeguard Mechanism reforms. ACCU prices are sensitive to the amount of on-site abatement undertaken by companies, the level of ACCU issuance and the actions of market participants. The market analysts explore alternative scenarios which result in higher or lower ACCU prices than their central estimates. In addition, EY publishes sensitivity analysis, a 10 and 90 percentile range from the sensitivity analysis for their central scenario is included in Figure 17.

[20] Safeguard facilities that exceed their baseline may apply to the CER to purchase the required number of ACCUs at a fixed price. The price of these ACCUs is set at $75 in 2023-24 and will be indexed in future financial years by the Consumer Price Index plus an additional 2% per annum.

**Figure 17 Forecast ACCU Prices by Market Analysts, 2024 to 2035, real 2024 $A per ACCU**




Note: ACCU price forecasts were converted into real 2023-24 $A by DCCEEW for charting purposes.

Sources:

Ernst & Young Australia 2023. Changing Gears: Australia's Carbon Market Outlook 2023.

RepuTex EnergyIQ Platform as of 1 November 2023.

Cost containment price from the Carbon Credits (Carbon Farming Initiative) Rule 2015.

# Sectoral trends

This section sets out the emissions projections associated with each sector under the baseline scenario, and where relevant, under the 'with additional measures' scenario. The sector breakdown is consistent with the international guidelines for reporting under the UNFCCC. These sectors are described in Table 10.

**Table 10 Sector coverage**

| Sector | Coverage |
|---|---|
| Electricity | Emissions from the combustion of fuels to generate electricity |
| Stationary Energy | Emissions from the combustion of fuels to generate steam, heat or pressure, other than for electricity generation and transport |
| Transport | Emissions from the combustion of fuels for transportation within Australia |
| Fugitive emissions from fuels | Emissions released during the extraction, processing and delivery of fossil fuels |
| Industrial processes and product use | Emissions from non-energy related industrial production and processes. Includes emissions from HFCs, which are used in refrigerants and air conditioning |
| Agriculture | Emissions from livestock, manure management, crop residue, rice cultivation, application of nitrogen to soils, and burning of agricultural residues |
| Waste | Emissions from the disposal of solid waste and wastewater |
| Land use, land use change and forestry | Emissions and sequestration from activities occurring on forest lands, forests converted to other land uses, grasslands, croplands, wetlands, settlements, and harvested wood products. |

# Electricity

33% of Australia's emissions in 2023

**Baseline**

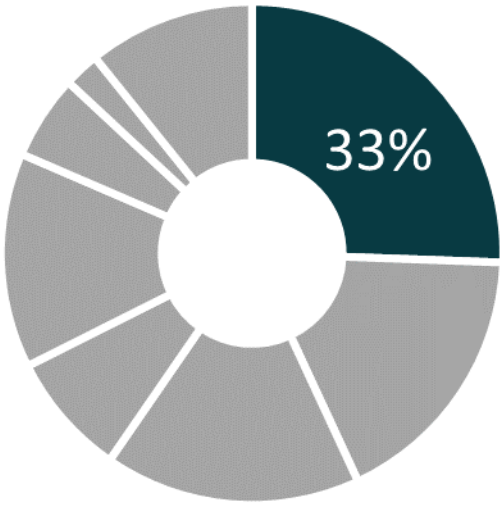
↓ 70 Mt $CO_2$-e 2023 to 2030

↓ 114 Mt $CO_2$-e 2023 to 2035

**With additional measures**

↓ 92 Mt $CO_2$-e 2023 to 2030

↓ 119 Mt $CO_2$-e 2023 to 2035




Emissions from electricity generation are the result of fuel combusted for electricity production in the NEM, Western Australia's Wholesale Electricity Market (WEM), other small grids and off-grid.

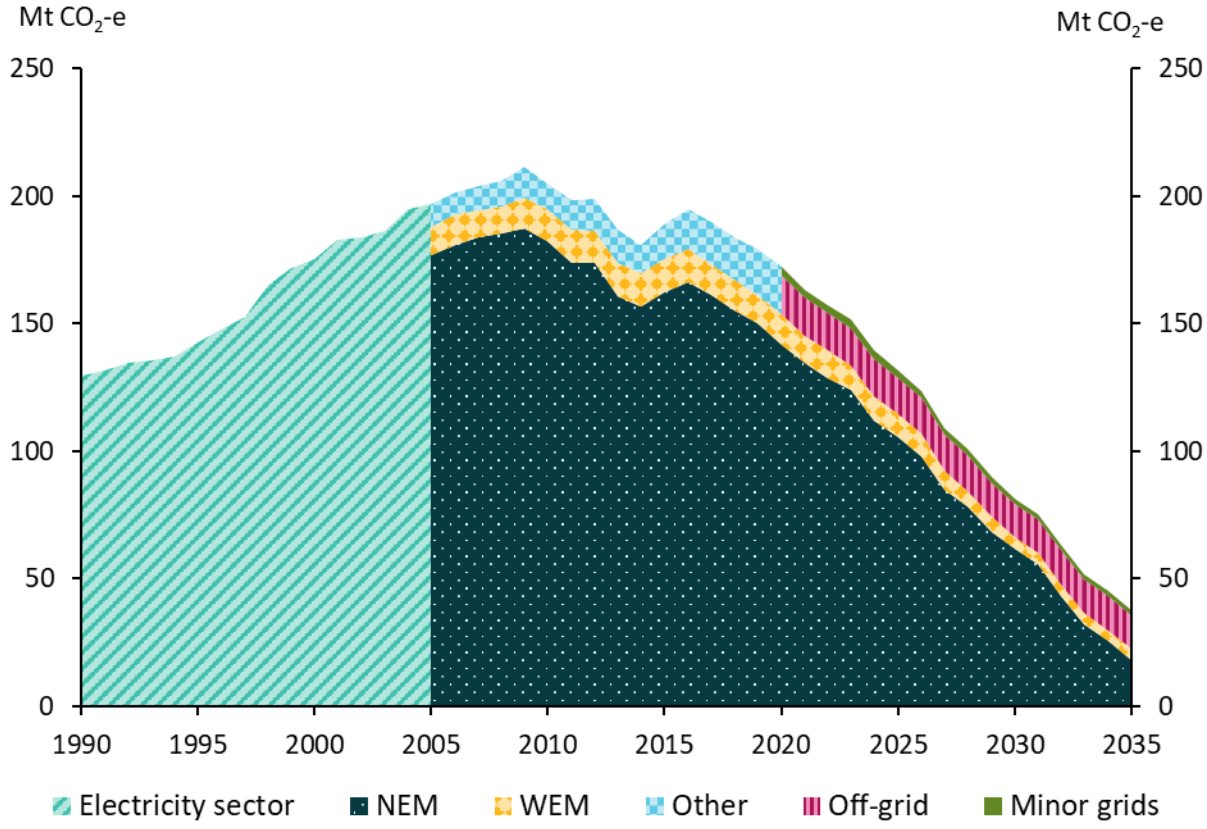
The NEM is the electricity market covering the east coast of Australia. It contains 5 regions – Queensland, New South Wales including the Australian Capital Territory, Victoria, Tasmania, and South Australia. The NEM represents approximately 80% of electricity generation in Australia. The WEM operates in the southwest of Australia. The other smaller grids are the Darwin-Katherine Interconnected System (DKIS) and the North-West Interconnected System (NWIS). Off-grid electricity generation, which includes micro-grids such as Alice Springs and Mount Isa, account for approximately 10% of national generation.

Full market modelling is completed for the NEM, WEM, and DKIS grids as part of the emissions projections.

## Emissions trends in the baseline scenario

Since 2016, emissions from electricity generation have been falling, driven by renewable generation entering the market and displacing fossil fuel fired generation. Electricity emissions are estimated to be 152 Mt $CO_2$-e in 2023 and are projected to decrease by 46% to 81 Mt $CO_2$-e in 2030. From 2023 to 2035 emissions decline by 75% to 37 Mt $CO_2$-e in 2035.

**Figure 18 Electricity emissions in the baseline scenario, 1990 to 2035, Mt $CO_2$-e**




Renewables like solar and wind form a growing share of generation to meet rising demand as fossil fuel-fired generation declines in the NEM. The inclusion of state renewable energy targets contributes to the projected decline in electricity emissions across the NEM and the DKIS. The New South Wales Electricity Infrastructure Roadmap[21] has been included in the emissions projections, along with state renewable energy targets in Queensland, Tasmania, and Victoria (Table 11). The Queensland Energy and Jobs Plan, Victoria's Energy Storage Targets[22] and Victoria's Offshore Wind Targets[23] also contribute to the projected decline in electricity emissions in the NEM. The DKIS includes the Northern Territory's renewable energy target. The WEM also sees large deployment of renewables and storage over the projections period due to the Western Australian Government's renewables announcement of 800 MW of new wind capacity and 2000 MWh[24] of storage.

Reforms to the Safeguard Mechanism, as they impact the electricity sector, are reflected in the electricity sector emissions projection. It is assumed that some non-electricity facilities covered by

[21] Targets: 12 GW of new renewable capacity and 2 GW of long-duration storage (e.g., pumped hydro storage) additional to Snowy 2.0 by 2030.

[22] Target of 2.6 GW of renewable energy storage capacity by 2030 and 6.3 GW by 2035.

[23] Offshore wind targets of 2 GW by 2032, 4 GW by 2035 and 9 GW by 2040.

[24] A megawatt (MW) is a unit of measurement for power capacity or how much power can be delivered; and a megawatt hour (MWh) is the electricity power generated from that capacity in 1 hour or how long the system can deliver that power.

the Safeguard Mechanism will choose to reduce emissions through fuel switching and electrification, and this contributes to additional electricity demand.

A number of coal generators are projected to close over the projections period to 2035, lowering the emissions intensity of generation. The projections include public closure announcements including Eraring power station in 2025 as well as the closure of all publicly owned coal-fired power stations in Queensland by 2035, in line with the Queensland Energy and Jobs Plan. The emissions projections include policies, transmission upgrades, and new or expanding projects as publicly announced.

**Table 11 State and territory renewable energy targets included and assumed to be met in the projections[25]**

| | 2030 | 2032 | 2035 |
|---|---|---|---|
| Victoria (VRET) | 65% | | 95% |
| Queensland (QRET) | 50% | 70% | 80% |
| Northern Territory (NTRET) | 50% | | |
| Tasmania (TRET)[26] | 150% | | |

The projections include federal policy announcements such as the CIS that had been announced prior to September 2023.[27] The CIS includes 600 MW of 4-hour duration battery storage to be built in South Australia and in Victoria. This year the projections also include updated assumptions regarding Snowy Hydro 2.0 with 2.2 GW of capacity by December 2028.

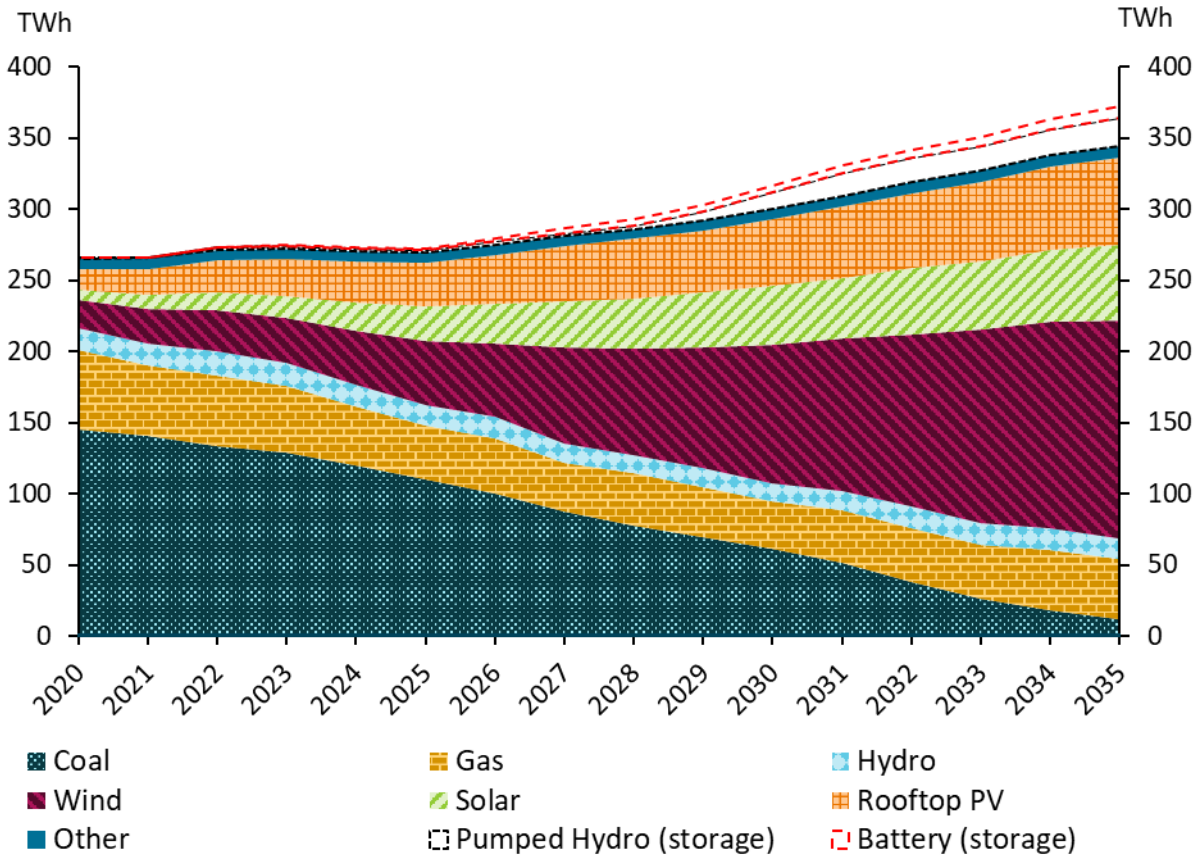
The increasing uptake of electric light duty vehicles and electrification of other parts of the economy are projected to increase electricity demand from 2023 to 2035.

[25] State and territory renewable energy targets are not included where the underpinning policy to reach the target is undergoing detailed design. Renewable share is defined in this table as renewable generation (as generated) over total generation (excluding storage in pumped hydro and batteries). The projections assume renewable build, including to meet state targets and plans as announced.

[26] Tasmania's interim renewable energy target accounts for exports.

[27] This includes the New South Wales Long Term Energy Service Agreements (LTESA) announcement for 550 MW of dispatchable renewable investment, and the target of 600 MW/2.4GWh of dispatchable capacity with 4-hour equivalent duration across South Australia and Victoria.

**Figure 19 Electricity generation mix in Australia in the baseline scenario, by fuel, 2020 to 2035, TWh**




Note: Figure 19 shows modelled projections from 2023 for as-generated generation[28] by fuel type.

## National Electricity Market (NEM)

Emissions in the NEM are projected to be 62 Mt $CO_2$-e in 2030 and 18 Mt $CO_2$-e in 2035 in the baseline scenario, a decrease of 106 Mt $CO_2$-e or 85% from 2023 to 2035. The share of renewable generation in the baseline scenario is projected to continue to grow to 73% in 2030 and further in the 'with additional measures' scenario.

### Demand and fuel mix in the NEM

The electricity emissions projections use the Australian Energy Market Operator's (AEMO's) forecast of underlying electricity demand from the 2023 Electricity Statement of Opportunities (ESOO) central scenario (Step Change) with further adjustments.[29] The NEM is projected to see growth in electricity demand out to 2035 as demand associated with population growth and electrification outweighs energy efficiency improvements.

[28] Total production of electricity before accounting for how much energy is consumed on the generator site.

[29] AEMO's electricity demand series is adjusted to account for the consumption of electricity from EVs, grid connected electrolyser demand and electrification consistent with modelling for the transport and stationary energy sectors in the projections, including in response to the Safeguard Mechanism reforms. It is also adjusted to account for the expected savings from current energy efficiency policies and measures, including savings from measures announced under the National Energy Performance Strategy (NEPS), based on advice from DCCEEW.

The electricity sector continues to be a key enabler for the decarbonisation of other sectors such as stationary energy and transport. However, with EVs starting from a low share of the national fleet, and with the increasing efficiency of EVs, consumption by EVs is projected to account for only 1% of total demand in the NEM in 2030 and 3% in 2035.

The projections also include new sources of electricity demand in the NEM in the form of electrolysers producing hydrogen.[30] By 2035 this represents a small amount of total demand. Several hydrogen policy announcements were not included in the 2023 electricity emissions projections baseline because they were still subject to ongoing consultation and detailed design at the point of modelling. Specifically, the Hydrogen Headstart program, Western Australia's Green Hydrogen Target, and the South Australia's Hydrogen Jobs Plan are not included in the projections. Interconnector projects such as CopperString 2032 contribute to additional demand in the NEM, connecting Mt Isa and Queensland's North West Minerals Province to the NEM by 2029.

### Renewables in the NEM

The NEM is projected to see renewable capacity, and pumped hydro and battery storage capacity, increase to 2035. Wind capacity contributes the most to renewable build out to 2035, with over 9 GW of wind build projected in each of the following 3 NEM states: New South Wales, Queensland, and Victoria. Tasmania also sees an increase in wind capacity, where export to the mainland is supported by the Marinus Link project. Rooftop photovoltaic (PV) capacity is projected to more than double from 17 GW in 2023 to 35 GW in 2030 and 46 GW in 2035. Small-scale battery storage installations are also projected to rise, with the ratio of small-scale batteries to rooftop system installations increasing from 2023 to 2035.

Large-scale renewables are projected to enter the NEM from 2023 in line with the Clean Energy Regulator (CER)'s large-scale projects pipeline, with new renewable capacity also projected to be built to meet state and territory renewable energy targets. The continued growth of wind and rooftop PV capacity in the projection slows the uptake of utility scale solar due to competition in the middle of the day.

### Reliability in the NEM

Increasing intermittent renewable generation requires more firming capacity in the NEM, leading to gas-fired generation being maintained throughout the baseline projection to 2035. Despite the grid being projected to reach 91% renewable generation in 2035, gas generation continues to play an important role in managing peak demand in the morning and evenings when solar output is lower. Battery storage is also deployed, with storage (including batteries and pumped hydro) projected to represent 19 GW or 15% of installed capacity in the NEM in 2030, and nearly 35 GW or 21% in 2035.

Interconnector capacity also supports the balancing of intermittent renewables across the NEM by allowing trade across different states and territories. Electricity traded each year across the NEM regions is projected to more than double by 2035. Rewiring the Nation is included to the extent that it supports delivery of state and territory renewable targets and plans, delivering new transmission

[30] The projections include hydrogen electrolyser projects that have received final investment decision (FID) and are included in CSIRO's HyResource database which includes a list of hydrogen-related, (industry) projects at different development stages in Australia: https://research.csiro.au/hyresource/projects/facilities/

and facilitating the connection of new renewable energy generation. The projections assume that the Marinus Link interconnector between Victoria and Tasmania will comprise of 2 cables each with 750 MW of capacity with Cable 1 and Cable 2 expected to be completed by 2028 and 2030 respectively.[31]

## Western Australia Wholesale Electricity Market (WEM)

Emissions in the WEM are projected to decline from 10 Mt $CO_2$-e in 2023 to 4 Mt $CO_2$-e in 2030 and 2035 in the baseline scenario, a decline of around 55%. The WEM is projected to increase renewable generation to meet demand as coal power stations close over the projections period, in line with the state government announcement.[32] Despite increasing renewable build and generation, gas continues to be an important source of generation, especially from 2030, as it supports the reliability of supply in the WEM as coal capacity exits and demand increases.

Large-scale solar and wind are the largest contributors to new build in the WEM from 2023 to 2035. However, rooftop PV is projected to maintain the largest total renewable capacity, with nearly 5 GW, representing 23% of capacity in the WEM in 2035. Wind generation increases significantly due to the Western Australian government's announced wind build, and as wind (along with other technologies such as solar and batteries) replaces coal in line with the announced closure of Muja D and Collie coal power stations.[33] To support this renewable generation, battery storage is built including the Kwinana and Collie big batteries supported by the Western Australian government's investment in energy security.

## Darwin-Katherine Interconnected System (DKIS)

Emissions in the DKIS are projected to be 0.8 Mt $CO_2$-e in 2030 and 2035 in the baseline scenario, a decline of 0.4 Mt $CO_2$-e from 2023. Emissions are projected to decrease in this grid due to less gas generation and more large-scale solar and rooftop PV build coming online to meet the Northern Territory government's 50% renewable energy electricity target by 2030. The DKIS is the largest grid in the Northern Territory but accounts for <1% of emissions in the national electricity sector in 2023.

Several gas generators in Darwin are expected to be retired in the projection period, in line with public announcements. To help mitigate reliability risks and balance intermittent generation sources, the DKIS includes a relatively large proportion of storage in the projection. Around 230 MW of battery storage are expected to be installed by 2035, representing over 15% of installed capacity in the grid.

[31] The electricity emissions projections baseline modelling was finalised prior to the federal and Tasmanian government's announcement relating to Marinus Link in September 2023. Marinus Link is working towards a delivery timeframe as close as possible to 2028; with negotiations to continue on a second cable, to be considered after the final investment decision on cable 1.

[32] The Western Australian state government has committed to introducing 810MW of wind and 1,100MW/4,400MWh of storage by 2030.

[33] Collie power station announced closure by late 2027 and Muja D power station announced closure in 2029.

## Off-grid electricity, and the North West Interconnected System (NWIS)

Emissions from off-grid electricity and the NWIS are projected to decline from 2023 to 2030 in the baseline scenario. Emission declines from increased renewables are partially offset by increased electricity use to support anticipated electrification and fuel-switching.

Electricity emissions in mining and remote communities (off-grid excluding LNG and the NWIS) are projected to decrease by 1 Mt $CO_2$-e from 2023 to 2035. Electricity demand is projected to grow by over 2,000 GWh over the projections period, including electrification from Safeguard facilities. Additional demand is met by increasing renewables generation, based on the assumption that mining operations and remote communities are likely to switch to hybrid systems to reduce reliance on high-cost liquid fuels over time. Around 2,200 MW of new renewable capacity is added to 2035, comprising large-scale solar, small-scale solar and wind.

**Table 12 Renewable share of electricity generation[34] in the baseline scenario, %**

| Grid, region | 2020 | 2025 | 2030 | 2035 |
|---|---|---|---|---|
| National Electricity Market | | 49 | 73 | 91 |
| *Queensland* | | 39 | 57 | 77[35] |
| *New South Wales/ACT* | | 44 | 82 | 95 |
| *Victoria* | | 46 | 64 | 99 |
| *South Australia* | | 92 | 97 | 88[36] |
| *Tasmania* | | 100 | 100[37] | 100 |
| Western Australia's Wholesale Electricity Market | | 38 | 71 | 76 |
| **On grid (NEM, WEM, NWIS, DKIS)** | | **48** | **72** | **89** |
| Off-grid | | 13 | 21 | 24 |
| **Total electricity sector** | **23[38]** | **44** | **67** | **83** |

[34] Renewable share is defined in this table as renewable generation (as generated) over total generation (excluding storage in pumped hydro and batteries). The projections assume renewable build, including to meet state targets and plans as announced. This includes the assumption that projects are completed without experiencing delays.

[35] Queensland's renewable energy target was considered under the projections as a consumption target. A consumption target takes account of factors, such as exports, that the number in the table does not.

[36] Despite increasing renewable generation, high demand across the NEM (especially post-2030) sees a projected increase in gas generation in South Australia in 2035.

[37] Renewable share is defined as noted above. Tasmania's interim renewable energy target accounts for factors, such as, exports that this number does not.

[38] Department of Climate Change, Energy, the Environment and Water, Australian Energy Statistics, Table O, June 2023 (financial year).

The NWIS is a relatively small grid serving the resource industry in the north-west of Western Australia. Emissions are projected to decline by <1 Mt $CO_2$-e from 2023 to 2035 as renewable supply makes up a growing share of generation, reflecting recent announcements from APA Group.[39]

Emissions associated with electricity production at LNG facilities occur when natural gas is combusted in on-site generators. Off-grid LNG electricity emissions are projected to remain relatively stable over the decade to 2030 and out to 2035. Electricity use in LNG facilities follows the trend of total LNG production, with abatement from renewables projected to be induced by the Safeguard Mechanism reforms. See the fugitive oil and gas section of the projections for further details on LNG production.

**Table 13 Installed capacity by technology in Australia in the baseline scenario, GW**

| Technology | 2020 | 2025 | 2030 | 2035 |
|---|---|---|---|---|
| Coal | 25 | 22 | 12 | 2 |
| Gas | 19 | 22 | 21 | 21 |
| Hydro | 6 | 6 | 7 | 7 |
| Wind | 7 | 15 | 31 | 47 |
| Large-scale solar | 3 | 13 | 20 | 25 |
| Rooftop PV | 12 | 25 | 40 | 52 |
| Other | 4 | 5 | 5 | 5 |
| Pumped hydro | 2 | 2 | 8 | 15 |
| Battery storage | <1 | 4 | 14 | 26 |
| **Total electricity sector** | **78** | **115** | **159** | **199** |

Note: totals may not sum due to rounding.

# Comparison to previous projections

Compared with the previous projections, electricity emissions in the baseline scenario are projected to be 3 Mt $CO_2$-e higher in 2030 and 29 Mt $CO_2$-e lower in 2035. Higher demand in AEMO's 2023 ESOO compared to the 2022 projection, and the assumed fuel-switching of non-electricity facilities covered by the Safeguard Mechanism sees electrification in other sectors, particularly stationary energy and transport. This increases the demand for electricity over the projection period compared to last year's projections. The revised demand outlook results in more thermal generation and therefore higher emissions in 2030 compared to the 2022 projection.

The 2023 projections also include reforms to the Safeguard Mechanism and the CIS in the baseline scenario for the first time. The greater emissions decline to 2035 is partially due to the inclusion of the updated Victorian Renewable Energy Targets and stronger wind generation overall from 2030 to 2035 compared to the 2022 projection.

[39] The NWIS is assumed to reach renewable energy percentages of around 60% in 2030, and 75% in 2040; in line with forecasts from APA Group for expected renewable supply in the Pilbara and reflects recent announcements from mining communities.

This year the projections also include updated assumptions regarding Snowy Hydro 2.0 with 2.2 GW of capacity by December 2028. The 2022 emissions projections assumed that Snowy Hydro 2.0 would be in commercial operation by November 2027 with 2 GW of capacity.

# Emissions trends in the 'with additional measures' scenario

The electricity sector emissions projections also include a 'with additional measures' scenario reflecting the Government's national renewable electricity target of 82% by 2030. The 'with additional measures' scenario assumes that the share of renewable energy is increased to 82% of electricity generated by 2030 in Australia's electricity grids: the NEM, WEM, DKIS and NWIS. Policy design and consultation is ongoing, so an assumption is made for the purposes of this scenario, that each grid individually reaches 82% renewable electricity generation by 2030. The 82% target will be supported by policies, including Rewiring the Nation and the CIS, that enable grid transformation and accelerate new transmission projections, increasing the availability of lower cost renewable generation and storage across Australia's grids.

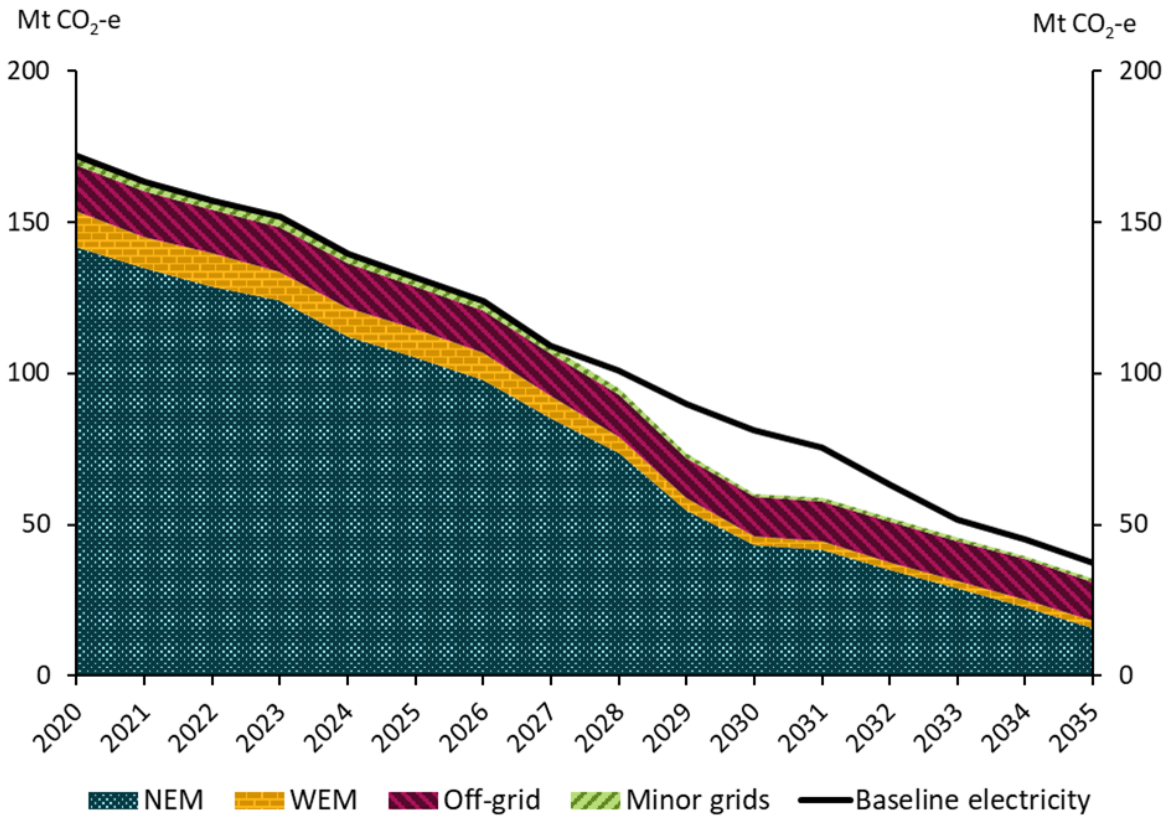
The 'with additional measures' scenario also includes further measures under the National Electric Vehicle Strategy, principally a fuel efficiency standard for light vehicles. These measures are expected to increase the uptake of EVs across Australia which in turn increases electricity demand.

Under the 'with additional measures' scenario, electricity emissions are projected to decline from 152 Mt $CO_2$-e in 2023 to 60 Mt $CO_2$-e in 2030 and 32 Mt $CO_2$-e in 2035. Australia's electricity emissions are projected to be 60% below 2023 levels in 2030 and 79% below 2023 levels in 2035. This is 26% lower (21 Mt $CO_2$-e) than the baseline electricity emissions projections in 2030.

The 'with additional measures' scenario includes higher generation from large-scale renewables like utility solar and wind and lower fossil fuel generation when compared with the baseline scenario. In the 'with additional measures' scenario, the share of renewable generation for on grid electricity (NEM, WEM, NWIS and DKIS) is projected to reach 82% in 2030.

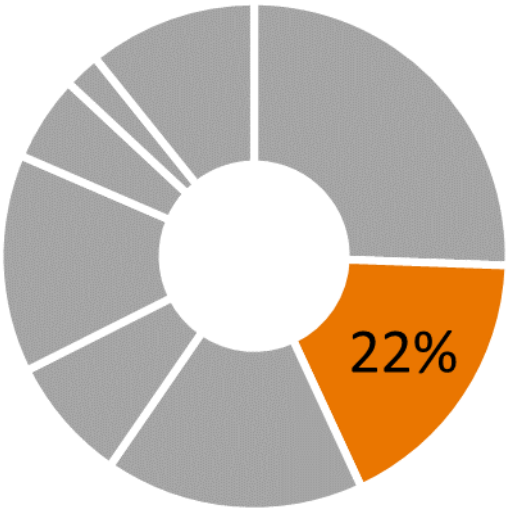
In the NEM in the 'with additional measures' scenario, emissions are projected to be 65% below 2023 levels in 2030 and 87% below 2023 levels in 2035. This is 30% lower in 2030 and 13% lower in 2035 compared to the baseline. In the WEM, emissions are projected to be 71% below 2023 levels in 2030 and 76% below 2023 levels in 2035 in the 'with additional measures' scenario. The impact of an 82% renewable energy target on smaller grids, the NWIS and DKIS, is a 1 Mt $CO_2$-e reduction in 2030 and 2035 when compared to the baseline scenario.

**Figure 20 Electricity emissions in the 'with additional measures' scenario, 2020 to 2035, Mt $CO_2$-e**



# Stationary Energy

22% of Australia's emissions in 2023
↓ 7 Mt $CO_2$-e 2023 to 2030
↓ 21 Mt $CO_2$-e 2023 to 2035




Stationary energy emissions result from the direct combustion of fuels, excluding those related to electricity generation and transport. Stationary energy emissions are produced in almost all sectors of the economy. The stationary energy sector consists of 6 subsectors: energy; mining; manufacturing; buildings; agriculture, forestry and fishing; and military.

## Emissions trends in the baseline scenario

Stationary energy emissions are estimated to be 104 Mt $CO_2$-e in 2023 and are projected to decrease by 7% to 96 Mt $CO_2$-e in 2030. From 2023 to 2035 emissions decline by 20% to 83 Mt $CO_2$-e in 2035 (Figure 21).

The impact of the Safeguard Mechanism reforms is the primary factor contributing to the projected emissions trend. Projected on-site emissions reductions from the Safeguard Mechanism reforms in 2030 is estimated to be 9 Mt $CO_2$-e, growing to 20 Mt $CO_2$-e in 2035.

### Manufacturing

The manufacturing subsector is the largest source of emissions within the stationary energy sector. Most manufacturing emissions (41% in 2023) come from the manufacture of basic non-ferrous metals such as alumina. About 93% of the basic non-ferrous metals emissions were from alumina refineries in 2023. Within the non-ferrous metals classification, projections indicate the share of alumina refineries' emissions will decline to 82% in 2035. Lithium refining, an emerging industry, will grow to 4% in 2030 and 5% in 2035. Other significant emission sources in manufacturing in 2023 are the manufacture of chemicals (24%) and non-metallic minerals (15%).

**Figure 21 Stationary energy emissions in the baseline scenario, 1990 to 2035, Mt $CO_2$-e**

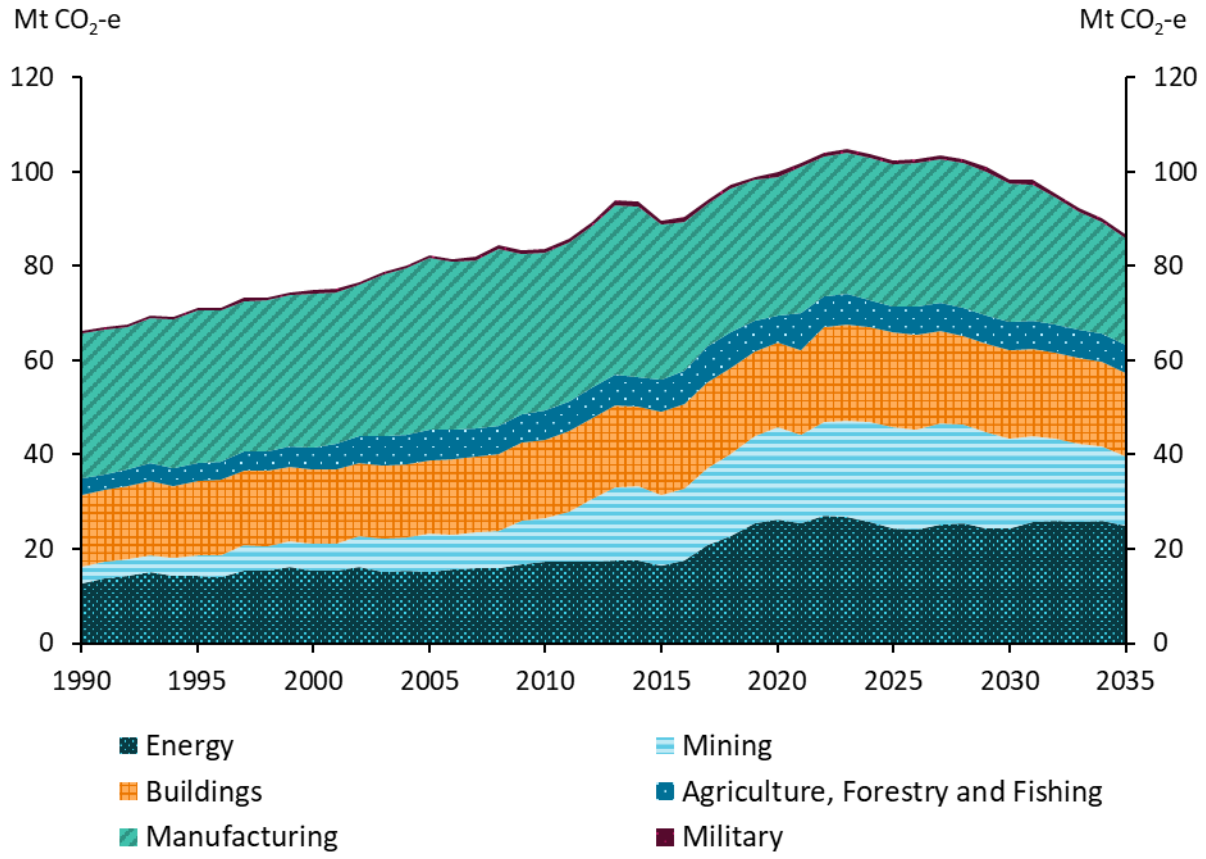



**Table 14 Manufacturing emissions in the baseline scenario, Mt $CO_2$-e**

| Emissions by subsector | 2005 | 2020 | 2025 | 2030 | 2035 |
|---|---|---|---|---|---|
| Non-ferrous metals | 14 | 12 | 13 | 12 | 6 |
| Non-metallic minerals | 6 | 5 | 5 | 5 | 5 |
| Iron and steel | 3 | 2 | 2 | 2 | 1 |
| Pulp, paper and print | 2 | 1 | 1 | 1 | 1 |
| Chemicals | 7 | 7 | 7 | 7 | 7 |
| Food processing, beverages, and tobacco | 4 | 3 | 2 | 2 | 2 |
| Other manufacturing | 1 | 1 | <1 | <1 | <1 |
| **Total** | **36** | **30** | **30** | **29** | **22** |

Note: totals may not sum due to rounding.

The emissions intensity of the manufacturing subsector is projected to improve, with production remaining relatively stable as emissions decline from 30 Mt $CO_2$-e in 2023 to 22 Mt $CO_2$-e in 2035 (see Table 14). This is mainly due to the projected impacts of the Safeguard Mechanism reforms including the uptake of cleaner fuels and technologies in the manufacturing sector, particularly after 2030. This is projected to deliver 3 Mt $CO_2$-e of on-site emissions reductions in 2030 and 9 Mt $CO_2$-e in 2035. Most of these reductions are attributed to the non-ferrous metals subsector (83% in 2030 and 2035), followed by the chemicals subsector (10% in 2030 and 2035).

In the early years of the Safeguard Mechanism reforms, most emission reductions are projected to come from incremental efficiency improvements through actions such as process optimisation, equipment turnover, and minor process changes. From 2030 onward, emissions reductions accelerate because of projected higher levels of technology uptake. Technologies include the replacement of fossil fuel combustion for heat with either net-zero or lower-emissions fuels (as a drop-in substitute or as a blend) or electrification across all subsectors. The uptake of MVR evaporators and the switch from coal to gas in the alumina industry further accelerates the trend.

Lower emissions from on-site abatement at existing facilities is partially offset by emissions from new facilities including the Covalent lithium hydroxide refinery in 2024 and the Perdaman chemical facility opening in late 2027.

## Energy

The energy sub-sector includes fuel combustion emissions from oil and gas extraction, natural gas production and distribution, solid fuel manufacture and petroleum refining. Emissions trends in the energy subsector are mainly driven by LNG production, which is the largest source of emissions in this subsector though its share is projected to decrease to 69% and 64% in 2030 and 2035, respectively (Table 15).

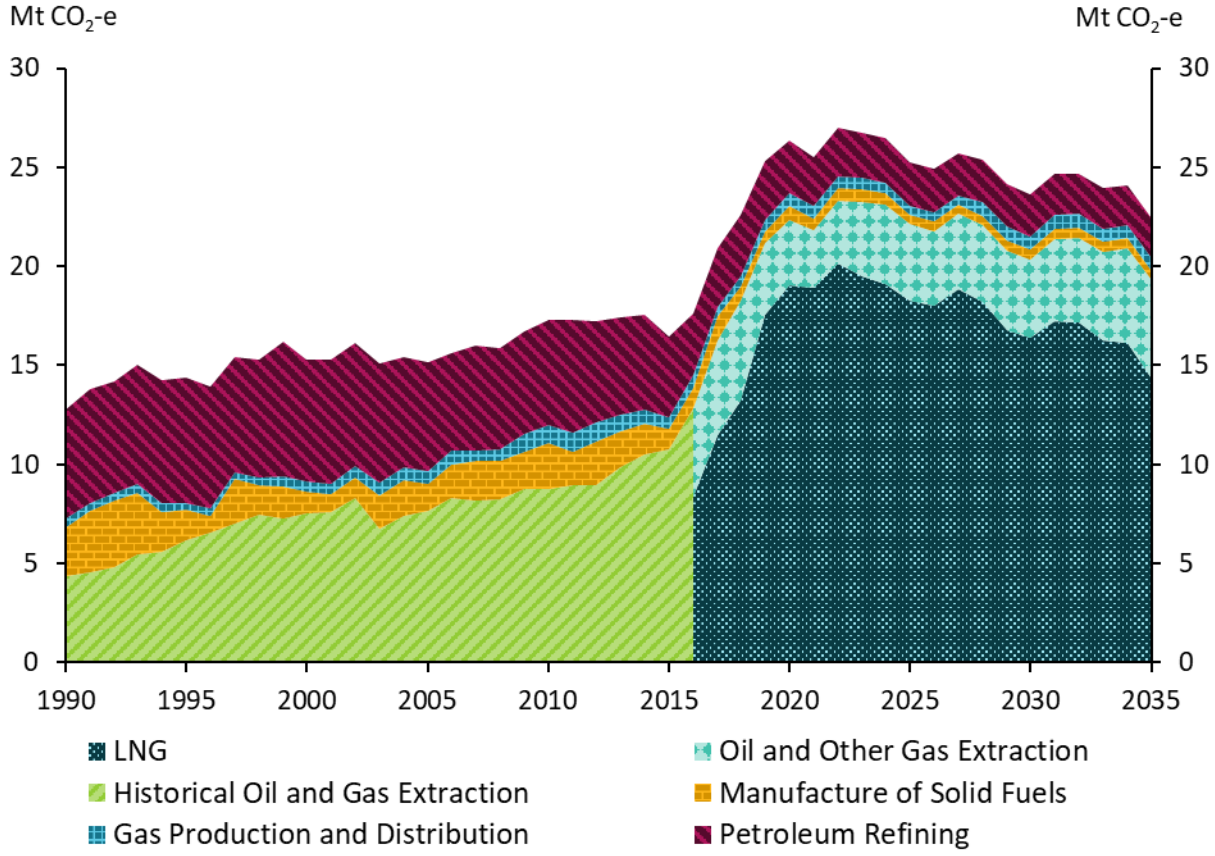
Emissions from the energy subsector are projected to decrease from 27 Mt $CO_2$-e in 2023 to 24 Mt $CO_2$-e and 22 Mt $CO_2$-e in 2030 and 2035, respectively. This is due to the projected impacts of the Safeguard Mechanism reforms through improvements in energy and process efficiency in the oil and gas sector and compressor electrification later in the decade. The on-site emissions reduction from Safeguard Mechanism reforms in the energy subsector is projected to be 3 Mt $CO_2$-e in 2030, growing to 6 Mt $CO_2$-e in 2035. The reduction is partly offset by higher emissions associated with LNG and domestic gas production post 2030. The 2023 projections have accounted for the closure of the Whyalla Steelworks coke ovens announced in September 2023 as the steelworks invests in new infrastructure.

**Table 15 Energy emissions in the baseline scenario, Mt $CO_2$-e**

| Emissions by subsector | 2005 | 2020 | 2025 | 2030 | 2035 |
|---|---|---|---|---|---|
| Oil and gas extraction | 8 | 22 | 22 | 20 | 19 |
| *LNG* | | 19 | 18 | 16 | 14 |
| *Oil and other gas* | | 3 | 4 | 4 | 5 |
| Manufacture of solid fuels | 1 | 1 | 1 | 1 | <1 |
| Gas production and distribution | 1 | 1 | <1 | 1 | 1 |
| Petroleum refining | 5 | 3 | 2 | 2 | 2 |
| **Total** | **15** | **26** | **25** | **24** | **22** |

Note: totals may not sum due to rounding.

**Figure 22 Energy subsector emissions in the baseline scenario, 1990 to 2035, Mt $CO_2$-e**




## Buildings

The building subsector includes all the emissions from fuel combustion in residential and commercial buildings as well as construction activities associated with infrastructure, and commercial and residential buildings. Overall, emissions in the building subsector are projected to decrease by 7% from 18 Mt $CO_2$-e in 2023 to 17 Mt $CO_2$-e in 2030, and then to 16 Mt $CO_2$-e in 2035 (Table 16). The increase in the emissions from construction is due to a projected growth in construction activities. In the combined residential and commercial subsectors, emissions decrease by 17% between 2023 and 2035 due to increasing electrification and energy efficiency improvements.

**Table 16 Building emissions in the baseline scenario, Mt $CO_2$-e**

| Emissions by subsector | 2005 | 2020 | 2025 | 2030 | 2035 |
|---|---|---|---|---|---|
| Construction | 2 | 2 | 2 | 3 | 3 |
| Residential | 9 | 11 | 10 | 9 | 8 |
| Commercial | 4 | 5 | 5 | 5 | 5 |
| **Total** | **16** | **18** | **18** | **17** | **16** |

Note: totals may not sum due to rounding.

## Mining

Mining subsector emissions consist of coal mining (49% in 2023) and other mining (51% in 2023). In 2023, other mining was primarily made up of emissions from iron ore (55%) and gold (22%) mining.

Stationary energy emissions from coal mining are projected to decline from 10 Mt $CO_2$-e in 2023 to 9 Mt $CO_2$-e and 7 Mt $CO_2$-e in 2030 and 2035 respectively. The reduction is driven by lower coal production due to lower international coal demand and the projected impact of the Safeguard Mechanism reforms.

Emissions from other mining are projected to decline by 9% from 10 Mt $CO_2$-e in 2023 to 9 Mt $CO_2$-e in 2030. Decarbonisation activities across the other mining subsector are projected to offset the emissions associated with increasing commodity production. The emissions are projected to decline further by 28% to 7 Mt $CO_2$-e between 2030 and 2035 (Table 17).

The Safeguard Mechanism reforms are projected to reduce on-site emissions in the mining subsector by around 3 Mt $CO_2$-e in 2030 and by 5 Mt $CO_2$-e in 2035. This is due to the projected energy efficiency improvements, electrification, and switching from diesel to low-carbon fuels across all mining equipment categories (e.g. haulage trucks, mining utes, excavators, loaders). The 2023 projections also account for decarbonisation activities in non-Safeguard facilities across the mining sub-sector.

**Table 17 Mining emissions in the baseline scenario, Mt $CO_2$-e**

| Emissions by subsector | 2005 | 2020 | 2025 | 2030 | 2035 |
|---|---|---|---|---|---|
| Coal | 5 | 10 | 10 | 9 | 7 |
| Other mining | 3 | 10 | 11 | 9 | 7 |
| *Iron* | | | 6 | 5 | 4 |
| *Gold* | | | 2 | 2 | 2 |
| *Copper, nickel, lithium* | | | 1 | 1 | 1 |
| *Other* | | | 1 | 1 | 1 |
| **Total** | **8** | **19** | **21** | **18** | **14** |

Note: totals may not sum due to rounding.

## Agriculture, forestry and fishing (energy use)

Emissions from energy use in agriculture, forestry and fishing activities, including fuel used for on-farm vehicles and machinery, is projected to decline from 8 Mt $CO_2$-e in 2023 to 7 Mt $CO_2$-e in 2025 and then remain relatively stable to 2035 (Table 19). Assumed fuel switching from diesel to electricity and energy efficiency improvements partly offsets the increased emissions from growth in production in this subsector.

## Military

The military subsector covers fuel use by military vehicles, for example, trucks and planes, and fuel used for training within Australia. This is the smallest subsector in the stationary energy projections. Emissions from the military subsector are projected to remain stable to 2035.

## Box 3 Alumina refinery emissions in the emissions projections[40, 41]

Alumina is aluminium oxide and is mainly used in the production of primary aluminium. There are currently six alumina refineries operating in Australia: two in Queensland and four in Western Australia. All alumina refineries are covered facilities under the Safeguard Mechanism. These refineries produced about 19 million tonnes of alumina in 2023, of which 86% was exported.

World alumina demand is forecast to rise driven by higher demand for aluminium in line with GDP and population growth, and due to increased use in renewable energy and other technologies important to the transition to a net zero economy.[39] Australia is the second largest producer, accounting for around 14% of global alumina production and is the world's largest exporter of alumina.[40] These projections assume Australia's alumina refineries will continue operating around current levels to 2035.

The alumina refining process involves four steps: digestion, clarification, precipitation, and calcination. Process heat for the alumina dissolution process, currently through steam from coal or gas fired boilers, is the most energy intensive part of the refining process. This is followed by gas consumption for the calcination process.

The emissions intensity of alumina production in Australia is projected to decrease to 2035 (Table 18). The stationary energy (excluding electricity) emissions of alumina refineries are projected to decline from 11 Mt $CO_2$-e in 2023 to 5 Mt $CO_2$-e in 2035. The decline in emissions is due to the projected impacts of the Safeguard Mechanism reforms on Alumina refineries. The industry is projected to transform its operations via energy efficiency improvements, electrification of process heat, switching from coal to gas-fired boilers, using hydrogen as a replacement for natural gas in the calcination process or through the uptake of the MVR technology, which is an energy recovery process that recycles waste heat to improve efficiency.

Another source of emissions from alumina production is electricity usage, including on-site generation and grid electricity use. Currently, around 55% of electricity emissions in alumina production relate to on-site electricity generation. Electricity consumption in alumina refineries is projected to increase as processes are electrified, noting the emissions intensity of Australia's electricity grids declines over the decade. Facilities will also switch to renewable electricity generation to decrease their scope 1 emissions under the Safeguard Mechanism reforms. The electricity-related emissions from on-site electricity generation and electricity drawn from the grid are projected to increase by 1% from 2.7 Mt $CO_2$-e in 2023 to 2.8 Mt $CO_2$-e in 2035.

**Table 18 Projected alumina production, alumina production emissions, and emissions intensity in the baseline scenario**

| Sector | 2023 | 2025 | 2030 | 2035 |
|---|---|---|---|---|
| Alumina production (Mt Alumina) | 19 | 20 | 21 | 21 |
| Electricity emissions* (Mt $CO_2$-e) | 3 | 3 | 2 | 3 |
| Stationary energy emissions (Mt $CO_2$-e) | 11 | 12 | 10 | 5 |
| Natural gas use (Mt $CO_2$-e) | 6 | 8 | 6 | 3 |
| Coal use (Mt $CO_2$-e) | 5 | 4 | 4 | 2 |
| Other fuel (Mt $CO_2$-e) | <1 | <1 | <1 | <1 |
| Total emissions (Mt $CO_2$-e) | 14 | 15 | 12 | 8 |
| Emissions intensity (Mt $CO_2$-e per Mt Alumina) | 0.73 | 0.73 | 0.59 | 0.38 |

Note: totals may not sum due to rounding.

*Electricity emissions include emissions from on-site electricity generation and electricity drawn from grid.

**Table 19 Stationary energy emissions in the baseline scenario, Mt $CO_2$-e**

| Emissions by subsector | 2005 | 2020 | 2025 | 2030 | 2035 |
|---|---|---|---|---|---|
| Manufacturing | 36 | 30 | 30 | 29 | 22 |
| Energy | 15 | 26 | 25 | 24 | 22 |
| Buildings | 16 | 18 | 18 | 17 | 16 |
| Mining | 8 | 19 | 21 | 18 | 14 |
| Agriculture, forestry and fishing | 7 | 6 | 7 | 7 | 7 |
| Military | 1 | 1 | 1 | 1 | 1 |
| **Total** | **82** | **100** | **102** | **96** | **83** |

Note: totals may not sum due to rounding.

# Comparison to previous projections

Compared to the previous projections, stationary energy emissions are 4 Mt $CO_2$-e and 10 Mt $CO_2$-e lower in 2030 and 2035, respectively. The change in stationary energy emissions is mainly due to the inclusion of the projected impacts of Safeguard Mechanism reforms in the manufacturing, energy and mining subsectors. This is partly offset by higher than projected emissions in the year 2023 as reported in the national greenhouse gas inventory.

[40] International Energy Agency (IEA) 2023, Energy Technology Perspective 2023, IEA, Paris

[41] Office of the Chief Economist (OCE) 2023, Resources and Energy Quarterly September 2023, Commonwealth of Australia, Canberra

# Transport

21% of Australia's emissions in 2023

**Baseline**

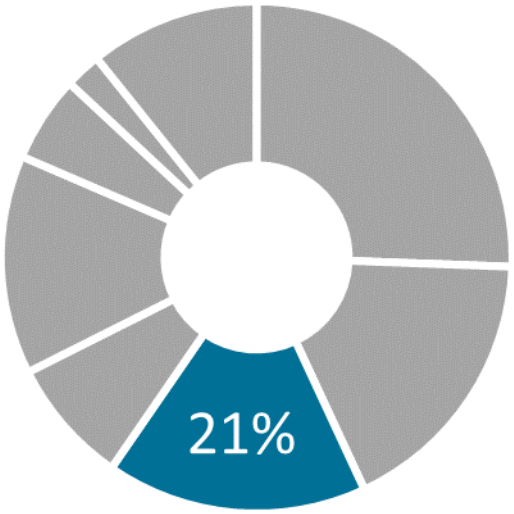
↑ 4 Mt $CO_2$-e 2023 to 2030

↓ 3 Mt $CO_2$-e 2023 to 2035

**With additional measures**

↓ 4 Mt $CO_2$-e 2023 to 2030

↓ 18 Mt $CO_2$-e 2023 to 2035




Emissions in the transport sector result from combusting fuels for mobility. This includes road, domestic aviation, rail, domestic shipping, off-road recreational vehicle activity, and gas pipeline transport. Road transport includes cars, light commercial vehicles (LCVs), articulated trucks, rigid trucks, buses, and motorcycles. Emissions from the generation of electricity used in EVs and rail are accounted for in the electricity sector.

## Emissions trends in the baseline scenario

Transport emissions were 100 Mt $CO_2$-e in 2019[42] and 93 Mt $CO_2$-e in 2020. Regulatory restrictions and behavioural change associated with the COVID-19 pandemic reduced transport activity from aviation and light duty vehicles. Emissions in the transport sector have remained below 2019 levels with emissions dropping to a low of 90 Mt $CO_2$-e in 2021. In 2023, emissions were still below pre-COVID-19 levels at 98 Mt $CO_2$-e. Over the period 2023 to 2030, transport emissions are projected to increase by 4%, from 98 Mt $CO_2$-e to 102 Mt $CO_2$-e. In 2035, transport emissions are projected to be 95 Mt $CO_2$-e, 3% lower than in 2023.

It is projected that from 2024 onwards, emissions from this sector will return to pre-pandemic levels. The projections include a small, long-term impact in activity to reflect changes in behaviour instigated by the pandemic, such as increased preferences for working from home. From 2024 onwards, emissions are projected to increase from 102 Mt $CO_2$-e in 2024 to a peak of 103 Mt $CO_2$-e in 2027, before declining to 95 Mt $CO_2$-e in 2035.

[42] As 2019 is the latest inventory year not impacted by reduced transport activity resulting from the COVID-19 pandemic, most of the trend analysis in this chapter has been made in reference to 2019.

**Table 20 Transport emissions in the baseline scenario, Mt $CO_2$-e**

| Technology | 2020 | 2025 | 2030 | 2035 |
|---|---|---|---|---|
| Articulated trucks | 12 | 13 | 14 | 14 |
| Buses | 2 | 2 | 2 | 2 |
| Cars | 41 | 45 | 42 | 37 |
| Domestic aviation | 7 | 9 | 8 | 8 |
| Domestic navigation | 2 | 2 | 2 | 2 |
| Light commercial vehicles | 17 | 18 | 18 | 18 |
| Motorcycles | <1 | <1 | <1 | <1 |
| Other transportation | 1 | 1 | 1 | 1 |
| Railways | 4 | 4 | 4 | 3 |
| Rigid trucks | 8 | 9 | 10 | 10 |
| **Total transport sector** | **93** | **102** | **102** | **95** |

Note: totals may not sum due to rounding.

**Figure 23 Transport emissions in the baseline scenario, 1990 to 2035, Mt $CO_2$-e**

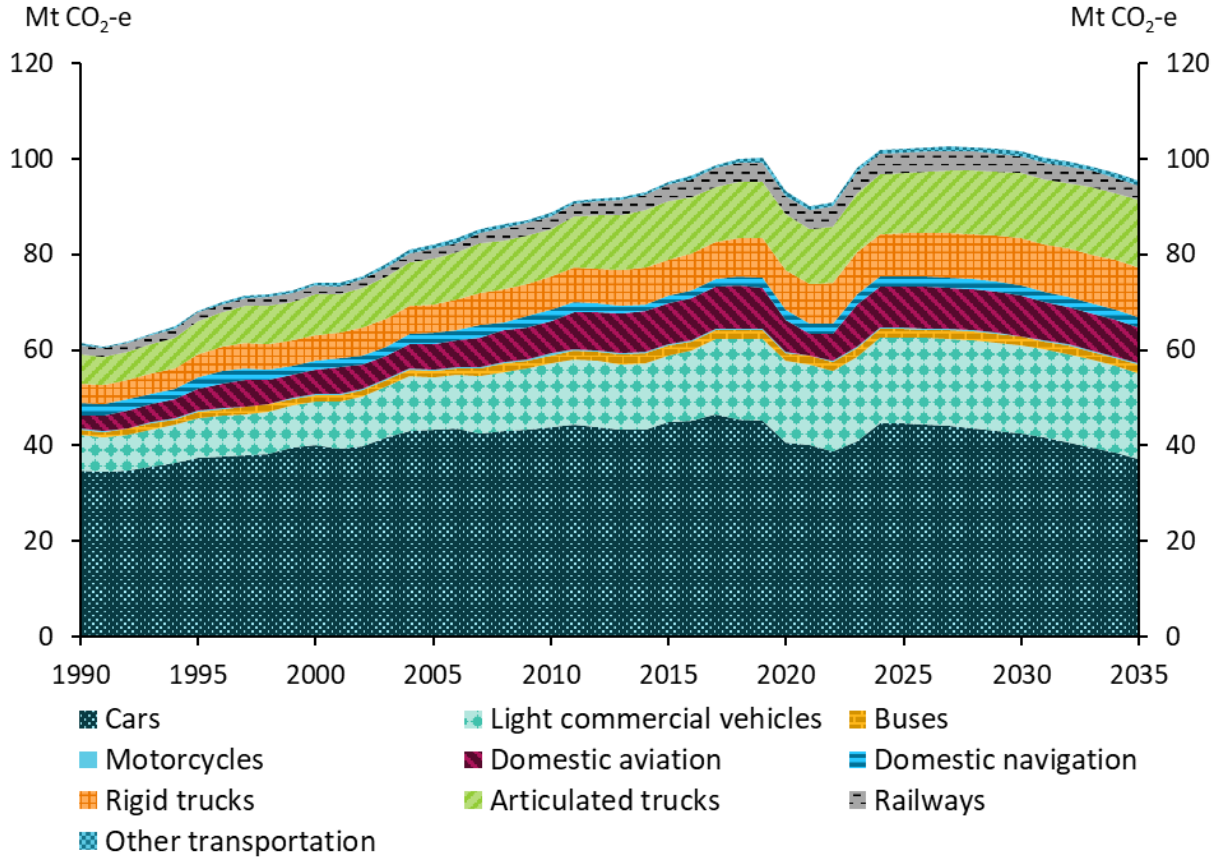
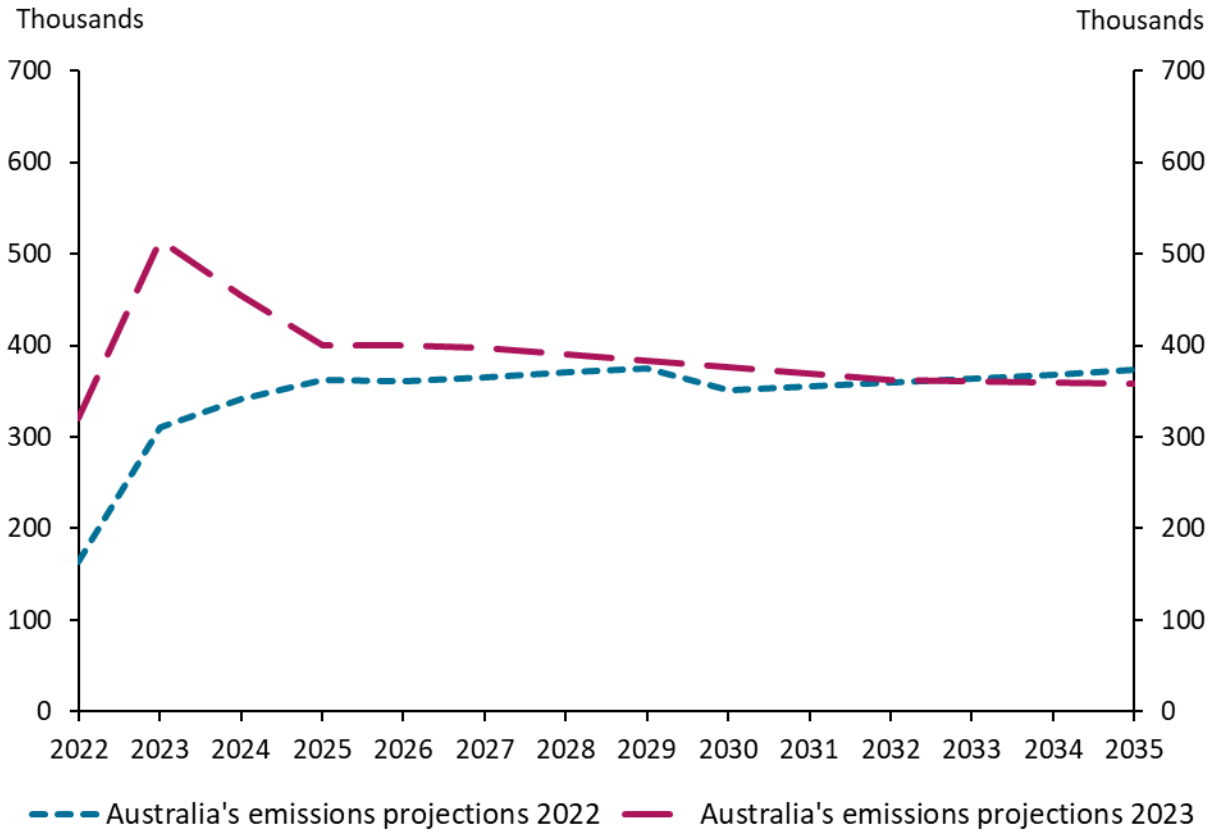



Figure 23 shows the main contributors to transport emissions in Australia are light duty vehicles, which includes cars and LCVs. In 2019, light duty vehicle emissions accounted for 62 Mt $CO_2$-e or 62% of all transport emissions. In 2030, emissions from light duty vehicles are projected to decline to 61 Mt $CO_2$-e and 55 Mt $CO_2$-e in 2035.

Growth in Australia's population is a key driver of increased demand for transport activity, in particular from cars, LCVs and domestic aviation. In 2023 Australia experienced an increase in immigration following previous restrictions due to the COVID-19 pandemic.[43] Population growth (Figure 24) from migration and births increased from 320,000 in 2022 to around 515,000 in 2023, resulting in higher demand for transport activity. However, the Centre for Population Projections (population.gov.au) expects growth to stabilise at around 350,000 per annum in the longer term, which is comparable to pre-COVID-19 levels.

**Figure 24 Comparison of projected annual population growth, 2022 to 2035, thousands**




Light duty vehicle activity is expected to increase because of population growth. This, alongside a trend towards larger passenger cars, such as Sport Utility Vehicles (SUVs), offsets the effects of fuel economy improvements and technology switching over the next few years, so emissions remain stable in the near term. As uptake of electric and hybrid vehicles increases, emissions in the light duty vehicle fleet segment begin to decline from around 2026.

In September the Federal Chamber of Automotive Industries[44] reported that Passenger Vehicles constituted 18% of new light duty vehicle sales for January to September 2023. SUVs constituted 59% of sales, and LCVs 23%. The VFACTS data shows EVs made up 13% of Passenger Vehicle sales and 9% of SUV sales. After factoring LCVs in, Battery EVs made up 7.6% of light duty vehicle sales and Plug-in

[43] "1.9% population growth driven by overseas migration", ABS, June 2023

[44] VFACTS measures vehicles sold by all Federal Chamber of Automotive Industries (FCAI) members. Numbers are published monthly on a subscription basis, and the September 2023 publication is referenced.

Hybrid EVs 0.8%, for a total share of 8.4%. This is more than double the 3.4% market share for January to September 2022.

Accelerating growth in EV sales is a global phenomenon, although Australia is currently lagging major international markets. In Australia the number of EVs in our Light Duty Vehicle stock are expected to reach 1.4 million by 2030 and increase to 3.6 million by 2035 in the baseline scenario. Additional measures under the National Electric Vehicle Strategy, including a fuel efficiency standard (which are included in the 'with additional measures' scenario, but not included in the baseline) would be expected to increase the uptake of EVs and hybrids in the light duty vehicle segment, as well as improve the efficiency of ICE vehicles.

**Figure 25 Projected technology mix for new light duty vehicle sales in the baseline scenario, 2023 to 2035, %**

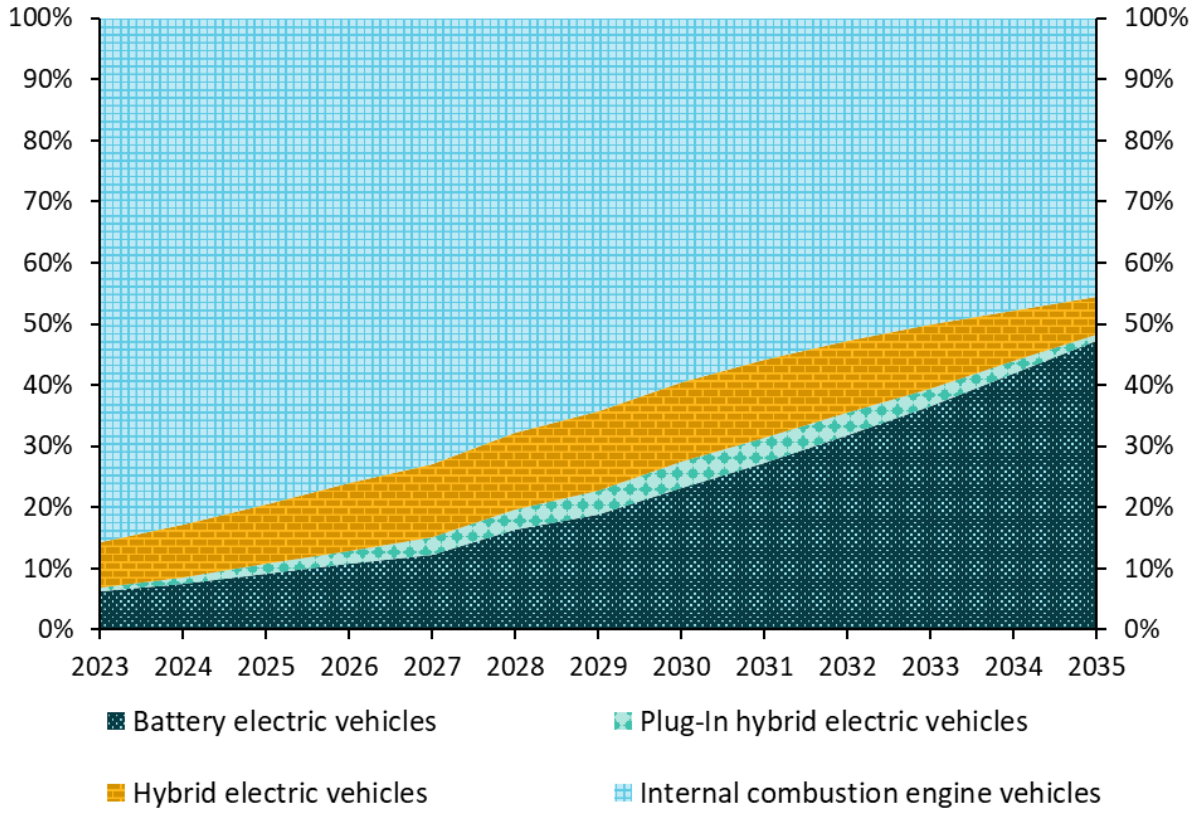



**Table 21 Projected light duty vehicle activity and EV stock and sales in the baseline scenario**

| | 2019 | 2025 | 2030 | 2035 |
|---|---|---|---|---|
| Activity (billion km travelled) | 235 | 249 | 266 | 281 |
| Number of EVs in the light duty vehicle stock ('000) | 17 | 348 | 1,405 | 3,636 |
| % of EVs in the light duty vehicle stock (%) | <1% | 2% | 7% | 18% |
| Number of EVs in new light duty vehicle sales ('000 per year) | 6 | 117 | 313 | 586 |
| % of EVs in new light duty vehicle sales (%) | <1% | 11% | 27% | 48% |

Note: EVs includes battery electric and plug-in hybrid vehicles.

Emissions from domestic aviation were 8 Mt $CO_2$-e in 2019, or 8% of total transport emissions. After dipping to 4 Mt $CO_2$-e in 2021 at the height of the COVID-19 pandemic, activity has broadly returned to pre-COVID-19 levels (8 Mt $CO_2$-e) in 2023. Emissions are projected to grow steadily with increased population increasing the demand for flights with emissions peaking at 9 Mt $CO_2$-e in 2027, after which they are expected to decline to 8 Mt $CO_2$-e in 2035. Although the aviation industry currently has limited cost-effective abatement options, by 2035 they are projected to reduce emissions by incorporating sustainable aviation fuels, make efficiency improvements through upgrades to the fleet and benefit from improved air traffic control systems that will reduce fuel consumption. These actions are induced in part by the Safeguard Mechanism reforms.

Aggregate emissions from freight transport (rail, articulated trucks, rigid trucks and domestic marine), unlike domestic aviation and light duty vehicles, were not materially impacted by the COVID-19 pandemic. In 2019, emissions in these sectors together were 26 Mt $CO_2$-e or 26% of total transport emissions, rising to 28 Mt $CO_2$-e (28%) in 2023. It is projected the emissions will peak at 30 Mt $CO_2$-e in 2033, after which emissions slowly decline, despite increased activity, as Safeguard facilities and other firms reduce their emissions including through electrification, use of hydrogen and efficiency improvements.

# Comparison to previous projections

Compared with the previous projections, transport emissions are projected to be 1 Mt $CO_2$-e lower in 2030 and 4 Mt $CO_2$-e lower in 2035. Emissions are lower in these projections due to higher projected take-up of EVs, an increased estimate of the work-from-home effect reducing demand for private road transport and projected actions from Safeguard facilities, in particular in the aviation, trucking and rail sectors to reduce their operational emissions. These declines in emissions are partially offset by higher than previously projected population levels. Although only a minor contributor, uptake of low emission buses is also slower than previously projected due to cost and technical challenges, leading to higher projected emissions.

# Emissions trends in the 'with additional measures' scenario

The Government's National Electric Vehicle Strategy made a number of new commitments including introducing a fuel efficiency standard for light vehicles. As the fuel efficiency standard is currently undergoing detailed design and consultation, and additional measures to enable investment in charging infrastructure and remove barriers to EV uptake are underway, these have not been included in the baseline scenario. However, for the 'with additional measures' scenario these measures have been included, with the standard assumed to commence in 2025.

The impact of these measures on Australia's emissions will depend on final policy settings; the level of uptake of EVs; complementary State and Territory policies; and interactions with the electricity sector (particularly the emissions associated with meeting higher demand for electricity). A wide range of emissions outcomes are possible due to these interactions and design decisions.

For the purposes of the 'with additional measures' scenario in these projections, the National Electric Vehicle Strategy measures including a fuel efficiency standard are assumed to reduce transport emissions by 7 Mt $CO_2$-e in 2030 and 15 Mt $CO_2$-e in 2035 compared with the baseline scenario. Over the period 2023 to 2030, emissions from the transport sector are projected to decrease by 4 per

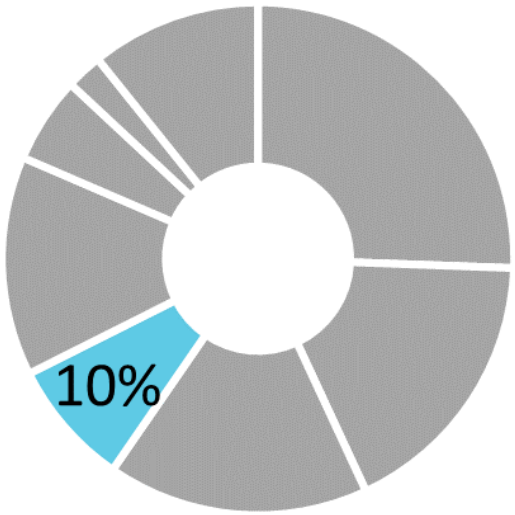
cent, from 98 Mt $CO_2$-e to 94 Mt $CO_2$-e. In 2035, transport emissions are projected to be 80 Mt $CO_2$-e, 18 per cent lower than in 2023.

In addition to reducing emissions from the transport sector, these further measures are expected to increase the uptake of EVs. The estimated increase in electricity demand has been taken into account in the electricity sector modelling in the 'with additional measures' scenario. Increased emissions in the electricity sector as a result of these measures are uncertain, but have been estimated to be 1 Mt $CO_2$-e in 2030 and 2035.

These estimates are based on stylised assumptions made for the purposes of these projections. The measures are subject to ongoing consultation, and these assumptions should not be interpreted as final policy design decisions.

# Fugitive emissions from fuels

10% of Australia's emissions in 2023
↓ 1 Mt $CO_2$-e 2023 to 2030
↓ 8 Mt $CO_2$-e 2023 to 2035




Fugitive emissions are released during the extraction, processing, and transport of fossil fuels. Fugitive emissions do not include emissions from fuel combusted to generate electricity, operate mining plant and equipment, or transport of fossil fuels by road, rail or sea.

Fugitive emissions are estimated to be 47 Mt $CO_2$-e in 2023 and are projected to decrease by 2% to 46 Mt $CO_2$-e in 2030. From 2023 to 2035 emissions decline by 18% to 39 Mt $CO_2$-e in 2035.

**Figure 26 Fugitive emissions in the baseline scenario, 1990 to 2035, Mt $CO_2$-e**

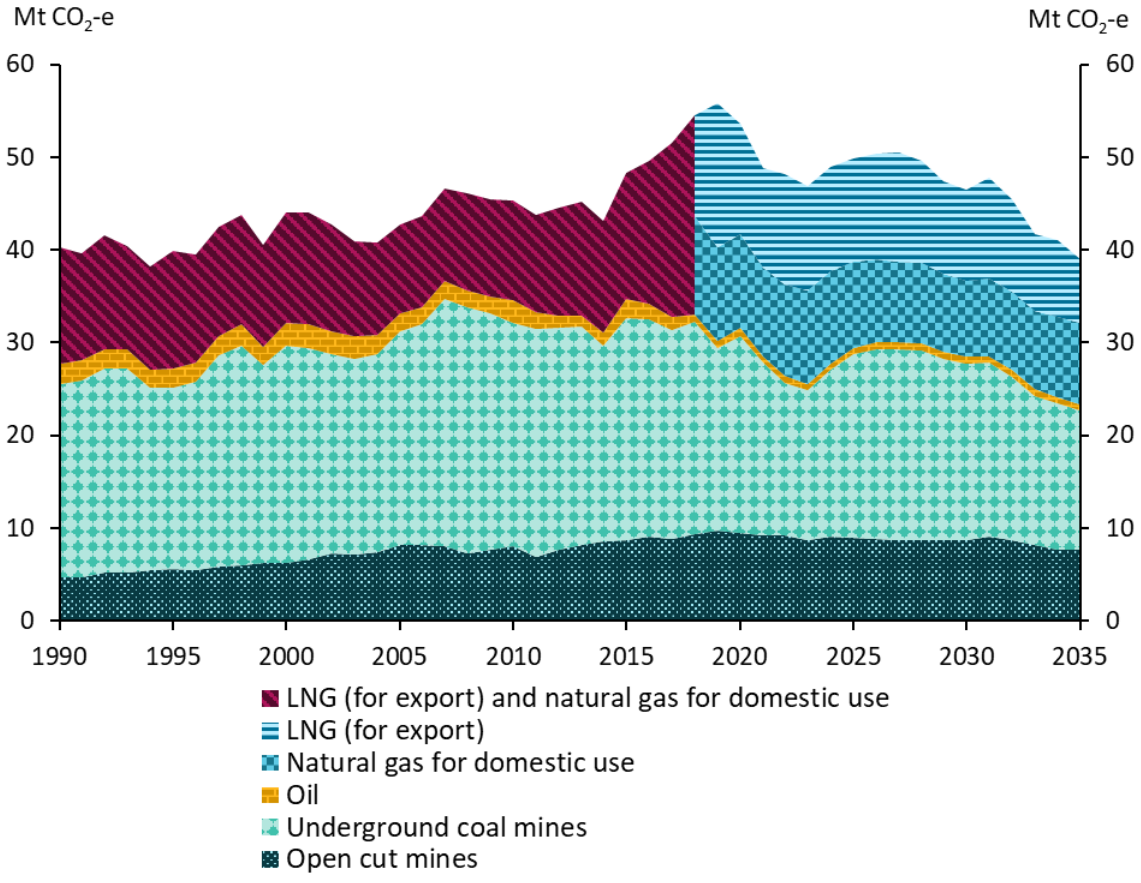


**Table 22 Fugitive emissions in the baseline scenario, Mt $CO_2$-e**

| Emissions by subsector | 2005 | 2020 | 2025 | 2030 | 2035 |
|---|---|---|---|---|---|
| Open cut mines | 8 | 9 | 9 | 9 | 8 |
| Underground coal mines | 23 | 21 | 20 | 19 | 15 |
| Oil | 2 | 1 | 1 | 1 | 1 |
| Domestic natural gas | 10[45] | 10 | 9 | 8 | 9 |
| Liquified natural gas | | 12 | 11 | 10 | 7 |
| **Total** | **43** | **54** | **50** | **46** | **39** |

Note: totals may not sum due to rounding.

# Coal fugitive emissions trends in the baseline scenario

Fugitive emissions from coal were 25 Mt $CO_2$-e in 2023 and accounted for 52% of all fugitive emissions. Emissions declined from 2021 to 2023 as several mines were impacted by flooding and other operational outages. Emissions are projected to increase in 2024 to 2026 as coal production returns to previous levels. Emissions are then projected to remain relatively steady to 2028 and then decline due to reduced demand for Australian thermal coal, increased on-site abatement activities induced by the Safeguard Mechanism reforms, and the closure of several large, gassy underground mines.

Fugitive emissions of carbon dioxide and methane are released during the extraction of coal. There is wide variation in the gas content across Australian coal basins and between coal fields within the basins. This is due to distinct geological and biogenic processes, such as how the coal was formed, tectonic history, and groundwater flows. This variability results in a small number of underground mines in the Southern, Hunter and Newcastle basins in New South Wales, and the Bowen Basin in Queensland, accounting for a large share of total emissions. There are over 90 operating coal mines in Australia. The 10 largest emitting mines account for around half of total coal fugitive emissions. The projections also include emissions from abandoned underground coal mines that continue to emit at a declining rate after they cease production.

The drivers of fugitive emissions are the amount of coal produced, the emissions intensity of the mine, and the amount of methane captured.

In 2021, 55% of the methane generated from underground coal mines was captured for flaring or electricity generation. This proportion is projected to increase as coal mines that are covered by the Safeguard Mechanism are expected to undertake on-site abatement actions to reduce their emissions. From 2024, abatement is expected from more thorough drainage and flaring of coal seams (before and after mining activities) and management of methane ventilation systems through improved seals and reduced leaks. Oxidation of ventilation air methane is projected to also contribute to abatement from 2035 as regulatory and technology barriers are overcome. On-site abatement from Safeguard facilities is projected to reduce coal fugitive emissions by 2 Mt $CO_2$-e in 2030 and 5 Mt $CO_2$-e in 2035.

[45] Includes domestic natural gas and LNG.

Australia's black coal production is projected to decline to 2035 (Table 23) as demand for thermal coal, used for electricity generation, is expected to fall while demand for metallurgical coal, to support global steel production is also projected to decline although at a slower rate.

**Table 23 Run-of-mine coal production in Australia in the baseline scenario, million tonnes[46]**

| | 2020 | 2025 | 2030 | 2035 |
|---|---|---|---|---|
| Black coal | 563 | 565 | 550 | 485 |
| *Thermal coal* | *315* | *325* | *303* | *250* |
| *Metallurgical coal* | *248* | *240* | *247* | *235* |
| Brown coal | 41 | 35 | 22 | 4 |
| **Total** | **605** | **600** | **572** | **488** |

Note: totals may not sum due to rounding.

Most of Australia's coal is exported to Japan, India and South Korea. These countries took receipt of over half of Australia's thermal and metallurgical coal exports in 2022-23.[47] Additional energy and climate change policies in these countries would impact the outlook for Australian coal production and could lead to lower production of Australian coal and consequently lower fugitive emissions.

Over 80% of Australia's coal is extracted from open cut coal mines, which have lower fugitive emissions per tonne of coal mined, compared with underground mines. This share is projected to remain relatively stable to 2035, in part because metallurgical coal is extracted from a higher proportion of underground mines compared with thermal coal.

Brown coal, which is consumed domestically for electricity generation in Victoria, has a small impact on fugitive emissions. Although brown coal currently accounts for 7% of Australia's coal production it accounts for less than 0.1% of fugitive emissions.

# Oil and gas fugitive emissions trends in the baseline scenario

Fugitive emissions from oil and gas are estimated to be 23 Mt $CO_2$-e in 2023, representing 48% of total fugitive emissions. Emissions are projected to decrease to 19 Mt $CO_2$-e in 2030 and 16 Mt $CO_2$-e in 2035. The main drivers of oil and gas fugitive emissions are levels of production, the geological characteristics of the basin and any capture of $CO_2$.

The Safeguard Mechanism is the primary driver of the projected decrease in oil and gas fugitive emissions. On-site emissions reduction at Safeguard facilities is projected to reduce oil and gas fugitive emissions by around 4 Mt $CO_2$-e in 2030, and 9 Mt $CO_2$-e in 2035.

[46] Run-of-mine coal production relates to the amount of raw material extracted from the mine. In their Resources and Energy Quarterly, the Office of the Chief Economist publishes forecasts of saleable coal, which is less than run-of-mine coal production. Saleable coal tends to average 80% of run-of-mine production, but it differs from mine to mine.

[47] Office of the Chief Economist (OCE) 2023, Resources and Energy Quarterly September 2023, Commonwealth of Australia, Canberra

## Oil

Fugitive emissions from oil were estimated to be 1 Mt $CO_2$-e in 2023 and are projected to remain around that level through to 2035. Crude oil and condensate production is projected to increase until 2028 and remain at that level to 2035. Refinery output is projected to decline until 2028 and remain at that level to 2035. The two petroleum refineries in Australia, Lytton (Queensland) and Geelong (Victoria), are assumed to operate near capacity to 2035.

## Domestic gas

Fugitive emissions from natural gas consumed in Australia (domestic gas) were estimated to be 10 Mt $CO_2$-e in 2023. They are projected to fall to 8 Mt $CO_2$-e in 2030, and increase to 9 Mt $CO_2$-e in 2035. The increase in fugitive emissions from 2030 to 2035 is the result of increasing gas production to meet domestic demand.

On-site emissions reductions induced by the Safeguard Mechanism are projected to reduce domestic gas fugitive emissions by around 2 Mt $CO_2$-e in 2030 and remain at that level to 2035. The predominant Safeguard on-site emissions reduction technology for domestic gas is CCS. Santos's CCS project at the Moomba plant is Australia's largest planned onshore CCS project. The projections assume operation will commence in 2025 and capture 1.5 Mt $CO_2$ per year. Other onshore domestic gas CCS projects are assumed to commence from 2032.

Domestic demand for gas is expected to continue over the projections period to 2035. From 2030, domestic gas production has been revised down since the 2022 emissions projections, with AEMO projecting the supply and demand balance in the east coast gas market to remain tight.[48] The 2023 emissions projections assume new gas extraction and production from the second half of the decade, including the development of gas fields in Narrabri, Beetaloo and Queensland, as well as associated pipeline developments to meet demand.

## Liquefied natural gas

Fugitive emissions from LNG (gas produced for export) have grown rapidly since 2015 as Australia's LNG industry has expanded. This emissions growth included high gas flaring activity that often occurred in the initial years of an LNG project (Figure 26). It is not expected that flaring emissions will reach these high levels again as Australia's newer LNG facilities move to a steadier state of operations over the projections period.

Fugitive emissions at LNG facilities were estimated to be 12 Mt $CO_2$-e in 2023. Emissions are projected to decline to 10 Mt $CO_2$-e in 2030 and 7 Mt $CO_2$-e in 2035.

LNG production in Australia is projected to remain at relatively constant levels over the period from 2024 to 2035, with a downward revision in LNG production from the North West Shelf facility.[49] Demand for LNG from Australia's traditional customer base of Japan, South Korea and Taiwan is projected to decline over the longer term as countries decarbonise their power and industrial sectors. However, LNG demand is projected to grow from China, and other regions in south Asia and

[48] AEMO 2023, 2023 Gas Statement of Opportunities, Australian Energy Market Operator Limited

[49] Office of the Chief Economist (OCE) 2023, Resources and Energy Quarterly September 2023, Commonwealth of Australia, Canberra

southeast Asia to meet growing energy demand. While sustained high LNG prices could slow demand growth from these countries, the International Energy Agency (IEA) still expects the Asia Pacific region to drive medium-term global gas demand growth.[50]

### Box 4 LNG-related emissions in the baseline scenario

Emissions related to LNG extraction and production are accounted for in three Intergovernmental Panel on Climate Change (IPCC) sectors in the emissions projections:

- Electricity
- Stationary energy (excluding electricity sector)
- Fugitive emissions from oil and gas

LNG-related emissions accounted for in the electricity and stationary energy sectors are emissions from the combustion of raw natural gas to run equipment, for example for driving compressors or generating electricity on-site.

Fugitive emissions from LNG are emissions released unintentionally – for example, from leaks from parts of equipment like valves, connectors, and flanges – or intentionally from venting and flaring in the exploration, extraction, production, processing, storage, and delivery of LNG. In Australia, emissions from gas venting and gas flaring have historically made up around 70% of total fugitive oil and gas emissions.

Venting emissions are the intentional release of methane and carbon dioxide as waste gas or process by-products, usually from routine operations. Flaring is the burning of excess gases that cannot be recovered or reused during plant operations, and for managing the pressure, flow, and composition of the gas in the production process.

**Table 24 LNG-related emissions in the baseline scenario**

| | 2020 | 2025 | 2030 | 2035 |
|---|---|---|---|---|
| LNG production (Mt) | **79** | **79** | **79** | **82** |
| Total LNG-related emissions (Mt $CO_2$-e) | **36** | **35** | **32** | **27** |
| *Electricity* | 6 | 6 | 6 | 6 |
| *Stationary energy* | 19 | 18 | 16 | 14 |
| *Fugitive emissions* | 12 | 11 | 10 | 7 |
| Emissions intensity (Mt $CO_2$-e per Mt LNG) | 0.5 | 0.4 | 0.4 | 0.3 |

Note: totals may not sum due to rounding.

On-site emissions reductions induced by the Safeguard Mechanism are projected to reduce LNG fugitive emissions by around 2 Mt $CO_2$-e in 2030, and around 6 Mt $CO_2$-e in 2035. Of these emissions reductions, CCS is assumed to account for 1 Mt $CO_2$-e in 2030 and 4 Mt $CO_2$-e in 2035. This does not include $CO_2$ captured at the Gorgon LNG plant, which has been capturing and storing $CO_2$ since August 2019. A number of other companies have announced intentions for CCS projects at their facilities. Safeguard facilities are also assumed to reduce flaring to reduce on-site emissions.

[50] International Energy Agency (IEA) 2023, Medium-Term Gas Report 2023 - Including the Gas Market Report, Q4-2023

**Map 1 LNG projects in Australia in 2023**


After being offline between 2023 and 2024, the Darwin LNG facility is assumed to resume production in 2025 with gas from the Barossa field. In 2027, the Crux field is assumed to provide backfill to the Prelude Floating LNG project. In 2030, the Browse basin is assumed to provide backfill gas to the North West Shelf LNG facility. As a result of the Barossa, Crux and Browse projects, fugitive venting emissions are projected to increase from 2025, noting that under the Safeguard Mechanism, new gas fields supplying LNG facilities will have a zero baseline for reservoir carbon dioxide emissions.[51]

The Pluto LNG expansion is assumed to go ahead in 2026. The expansion includes the construction of a second train at the Pluto LNG onshore facility with gas sourced from the Scarborough field, which is a relatively low carbon dioxide field compared with most other fields currently supplying offshore gas.

Emissions outcomes would be different if projects were to commence on a different timeline.

# Comparison to previous projections

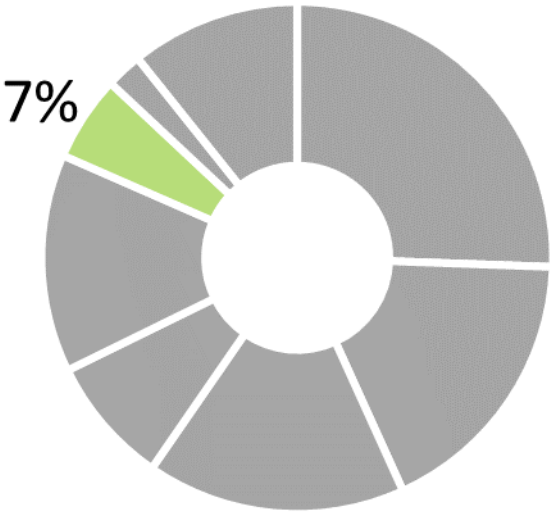
Compared with the previous projections, fugitive emissions from coal are projected to be 1 Mt $CO_2$-e lower in 2030 and 5 Mt $CO_2$-e lower in 2035. This is largely due to increased projected methane capture activities due to the Safeguard Mechanism and a lower forecast for Australian coal production.

Compared with the previous projections, fugitive emissions from oil and gas are projected to be 8 Mt $CO_2$-e lower in 2030 and 11 Mt $CO_2$-e lower in 2035. This decrease is primarily due to the projected impacts of the Safeguard Mechanism and the downward revision of LNG production volumes. Compared with the previous projections, LNG production is projected to be 10% lower in 2030 and 5% lower in 2035.

[51] Section 35A of Schedule 1, National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule

# Industrial Processes and Product Use

7% of Australia's emissions in 2023
↓ 8 Mt $CO_2$-e 2023 to 2030
↓ 12 Mt $CO_2$-e 2023 to 2035




The IPPU sector includes emissions from non-energy related production processes. Emissions from this sector include by-product gases from chemical reactions in production processes, the release of synthetic greenhouse gases from commercial and household equipment, combustion of lubricant oils not used for fuels, and carbon dioxide used in food and beverage production. Energy-related emissions are accounted for in the stationary energy sector.

Table 25 lists the subsectors that comprise the IPPU sector and the main production processes that drive emissions from these subsectors.

**Table 25 Production processes in industrial processes and product use**

| Subsector | Main production processes |
|---|---|
| Metal industry | Iron and steel, and aluminium production |
| Chemical industry | Ammonia, nitric acid and titanium dioxide production |
| Mineral industry | Cement clinker and lime production |
| Product uses as substitutes for ozone depleting substances | HFCs used in refrigeration and air conditioning equipment, foam, fire protection and aerosols |
| Non-energy products from fuel and solvent use | Emissions from lubricant oils not used for fuel |
| Other production | Carbon dioxide used in food production |
| Other product manufacture and use | Sulphur hexafluoride used in electrical switchgear |

## Emissions trends in the baseline scenario

IPPU emissions are estimated to be 32 Mt $CO_2$-e in 2023 and are projected to decrease by 24% to 25 Mt $CO_2$-e in 2030. From 2023 to 2035 emissions decrease by 37% to 21 Mt $CO_2$-e in 2035. This decrease in emissions is primarily due to assumed on-site emissions reductions at Safeguard facilities and a projected decline in emissions from HFCs. The projected Safeguard on-site emissions reduction is assumed to be 4 Mt $CO_2$-e in 2030, and 6 Mt $CO_2$-e in 2035. Emissions from HFCs are projected to decrease from 11 Mt $CO_2$-e in 2023 to 6 Mt $CO_2$-e in 2035.

**Figure 27 Industrial processes and product use emissions in the baseline scenario, 1990 to 2035, Mt $CO_2$-e**

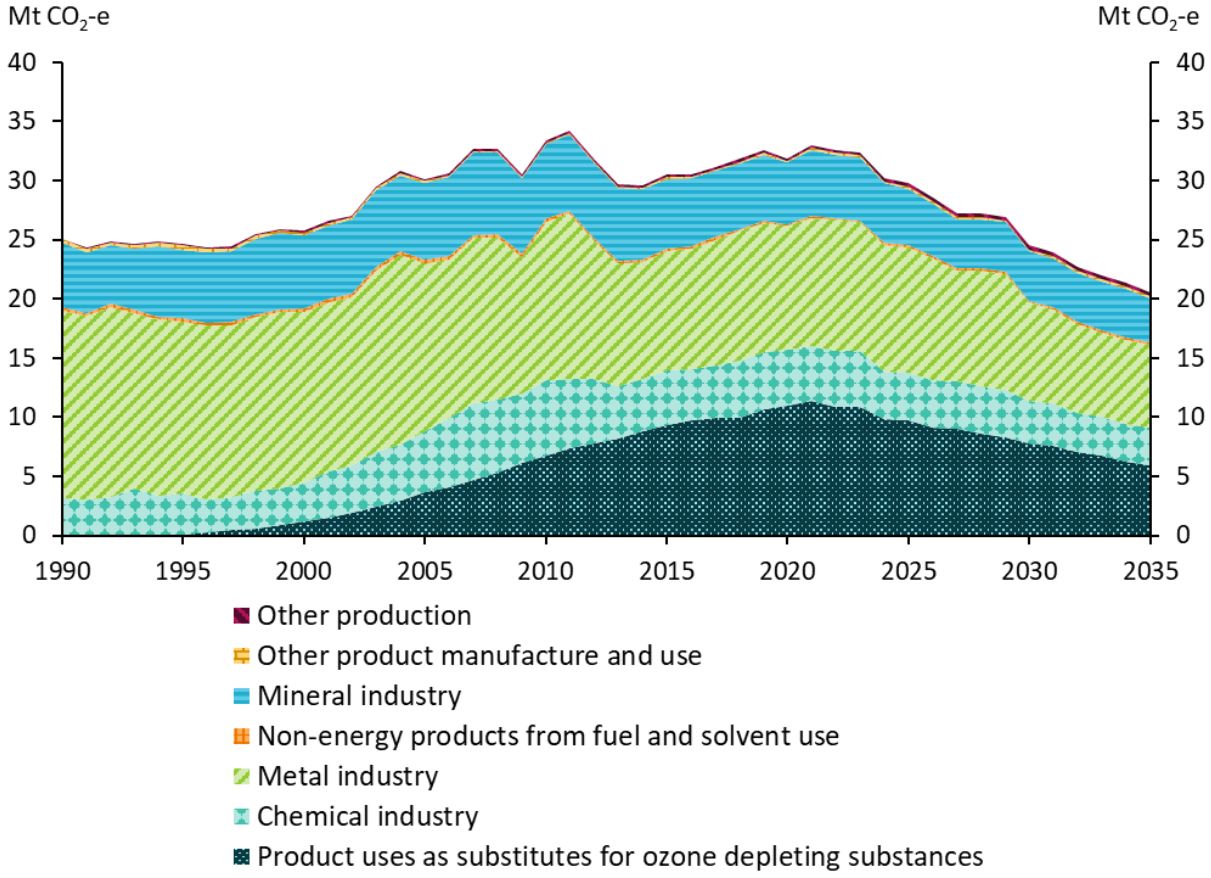



**Table 26 Industrial processes and product use emissions in the baseline scenario, Mt $CO_2$-e**

| Emissions by subsector | 2005 | 2020 | 2025 | 2030 | 2035 |
|---|---|---|---|---|---|
| Product uses as substitutes for ozone depleting substances | 4 | 11 | 10 | 8 | 6 |
| Metal industry | 14 | 10 | 11 | 8 | 7 |
| Chemical industry | 5 | 5 | 4 | 4 | 3 |
| Mineral industry | 6 | 5 | 5 | 4 | 4 |
| Non-energy products from fuel and solvent use | <1 | <1 | <1 | <1 | <1 |
| Other production | <1 | <1 | <1 | <1 | <1 |
| Other product manufacture and use | <1 | <1 | <1 | <1 | <1 |
| **Total** | **30** | **32** | **30** | **25** | **21** |

## Hydrofluorocarbon emissions

The largest source of emissions in the IPPU sector in 2023 is the *Product uses as substitutes for ozone depleting substances* subsector (or HFCs), which contributes 11 Mt $CO_2$-e of emissions (33% of total IPPU emissions).

Emissions from HFCs are projected to decline from 11 Mt $CO_2$-e in 2023 to 6 Mt $CO_2$-e in 2035. This is the result of the HFC phase-down implemented through the *Ozone Protection and Synthetic*

*Greenhouse Gas Management Act 1989* and associated regulations. The HFC-phase down legislates a reduction of the annual import quota on bulk imports of HFCs until 2036.

The projections also include the impact of proposed measures to inform refrigeration and air-conditioning equipment owners of the benefits of regular maintenance. These measures will reduce refrigerant leaks, improve the energy performance of refrigeration and air-conditioning equipment, and reduce emissions from HFCs. These measures are also expected to lower electricity use delivering further electricity sector emission reductions.

## Metal industry emissions

The metal industry is the second largest source of emissions in the IPPU sector in 2023, contributing 11 Mt $CO_2$-e of emissions (33% of total IPPU emissions). Emissions are projected to decrease to 8 Mt $CO_2$-e in 2030, and 7 Mt $CO_2$-e in 2035.

This decrease in emissions is driven by the impact of the Safeguard Mechanism, which is projected to drive on-site emissions reductions in the metal industry of 3 Mt $CO_2$-e in 2030 and 4 Mt $CO_2$-e in 2035. Emissions reductions are expected to occur through technological improvements in steelworks facilities, such as the uptake of natural gas direct reduction (DR) and electric arc furnace (EAF) processes and the use of biochar to replace coke, as well as the replacement of carbon anodes with inert anodes in aluminium refining facilities.

## Other industry emissions

Chemical industry emissions accounted for 15% of emissions in the IPPU sector in 2023. Emissions from the chemical industry subsector are projected to decrease from 5 Mt $CO_2$-e in 2023 to 3 Mt $CO_2$-e in 2035. The decrease in chemical industry emissions is driven by the projected impact of the Safeguard Mechanism, through catalytic reduction of $N_2O$ in the production of ammonium nitrate production and the use of green hydrogen in other chemical processes.

Mineral industry emissions made up 17% of emissions in the IPPU sector in 2023 and are projected to decrease from 5 Mt $CO_2$-e in 2023 to 4 Mt $CO_2$-e in 2035. This reflects reductions in emissions from cement production, which accounted for 53% of mineral industry emissions in 2023. The reductions are due to projected declines in domestic clinker production. These emissions reductions are somewhat offset by increased lime production. There remains limited opportunities for emissions reductions in the cement industry due to economic and technical challenges.[52, 53]

[52] Journal of Environmental Sciences, Vol 104, June 2021, pages 84-101, Challenges against $CO_2$ abatement strategies in cement industry: A review

[53] International Energy Agency (IEA) 2023, Cement, Paris, License: CC BY 4.0

## Box 5 Aluminium smelter emissions in the baseline scenario[54, 55]

Global primary aluminium demand is forecast to rise in line with GDP and population growth. Primary aluminium is used in renewable energy and other technologies that are important to the transition to a net zero economy (e.g. EV and battery storage, hydrogen electrolysers and fuel cells).

There are currently 4 aluminium smelters operating in Australia: Bell Bay (Tasmania), Boyne Island (Queensland), Portland (Victoria) and Tomago (New South Wales). These smelters produce around 1.6 million tonnes of primary aluminium per year of which approximately 90% is exported. These projections assume Australia's 4 aluminium smelters will continue operating around current levels to 2035. The export value of Australia's aluminium in 2023 was $5.3 billion.

The largest source of emissions for an aluminium smelter is indirect emissions associated with electricity generation known as Scope 2 emissions. These emissions occur at the electricity power stations and not at the aluminium smelter itself. Emissions from this source (estimated using electricity grid average emission factors) are projected to fall as the emissions intensity of the grid declines to 2035.

Stationary energy (excluding electricity) emissions are a relatively small source and are mostly associated with the combustion of natural gas to bake carbon anodes in the smelting process and control the temperature of molten aluminium in the casting process. IPPU emissions are primarily the carbon dioxide emitted from the oxidation of the carbon anodes. This source also includes perfluorocarbon emissions.

Emissions from aluminium production are projected to decline from 16 Mt $CO_2$-e in 2023 to 3 Mt $CO_2$-e in 2035, primarily due to the decarbonisation of Australia's electricity generation. Emissions from stationary energy (excluding electricity) are projected to remain relatively steady. Industrial process emissions are projected to decrease as a result of onsite emissions reductions driven by the Safeguard Mechanism reforms. This means the emissions intensity of aluminium smelting is projected to decrease by 80% between 2023 and 2035 (Table 27).

**Table 27 Projected primary aluminium production, aluminium smelters emissions and emissions intensity in the baseline scenario**

| | 2023 | 2025 | 2030 | 2035 |
|---|---|---|---|---|
| Aluminium production (Mt) | **1.5** | **1.6** | **1.6** | **1.6** |
| Total Aluminium smelter emissions (Mt $CO_2$-e) | **16** | **15** | **8** | **3** |
| *Electricity (indirect emissions)* | 14 | 12 | 6 | 2 |
| *Stationary energy* | <1 | <1 | <1 | <1 |
| *Industrial processes* | 2 | 3 | 1 | 1 |
| Emissions intensity (Mt $CO_2$-e per Mt aluminium) | 11.0 | 9.4 | 4.8 | 2.0 |

Note: totals may not sum due to rounding.

[54] Office of the Chief Economist (OCE) 2023, Resources and Energy Quarterly September 2023, Commonwealth of Australia, Canberra

[55] International Energy Agency (IEA) 2023, Aluminium, Paris, License: CC BY 4.0

### Box 6 Iron and steel production emissions in the baseline scenario[56]

The emissions intensity of iron and steel production in Australia is projected to decline to 2035 (Table 28), as opportunities for natural gas DR and EAF processes are assumed to be adopted.

The majority of Australia's steel is produced by two large integrated steelworks: Whyalla (South Australia) and Port Kembla (New South Wales). In 2023, Australia produced about 6 Mt of steel.

The largest source of emissions from iron and steel production is the use of coke and pulverised black coal as a reductant in the blast furnace. Emissions from the consumption of electricity and from the stationary energy fuel combustion of the coke ovens and blast furnaces are also sources of emissions, albeit smaller.

Global emissions from steel production are estimated to be around 7% of total global emissions. To meet global energy and climate goals, the IEA says that emissions from the steel industry will be required to decrease emissions by around 50 per cent by 2050. One way to do this may be through the production of green steel, using green hydrogen to provide the energy required for the steel-making process.

**Table 28 Projected steel production, steel production emissions and emissions intensity in the baseline scenario**

| | 2023 | 2025 | 2030 | 2035 |
|---|---|---|---|---|
| Steel production (Mt) | **6** | **6** | **6** | **6** |
| Total steel-related emissions (Mt $CO_2$-e) | **11** | **10** | **9** | **7** |
| *Electricity (indirect emissions)* | 1 | 1 | <1 | <1 |
| *Stationary energy* | 2 | 2 | 2 | 2 |
| *Industrial processes* | 8 | 7 | 6 | 5 |
| Emissions intensity (Mt $CO_2$-e per Mt steel) | 1.9 | 1.8 | 1.5 | 1.2 |

Note: totals may not sum due to rounding.

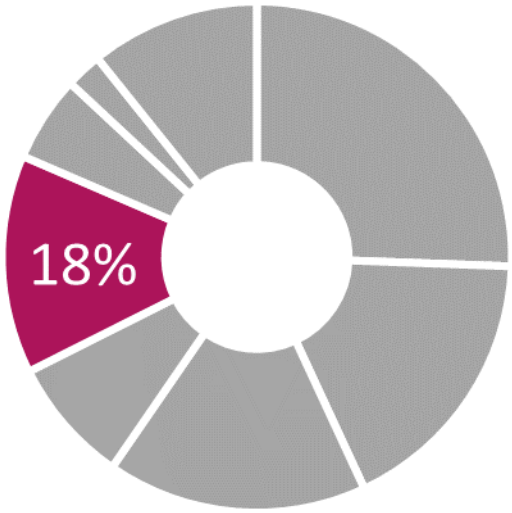
# Comparison to previous projections

Compared with the previous projections, IPPU emissions are projected to be 4 Mt $CO_2$-e lower in 2030 and 5 Mt $CO_2$-e lower in 2035. This decrease in IPPU emissions is mainly due to the assumed emissions reductions at Safeguard facilities, especially in the metal and chemical industry.

[56] International Energy Agency (IEA) 2023, Iron and Steel Technology Roadmap – Analysis, Paris, License: CC BY 4.0

# Agriculture

18% of Australia's emissions in 2023
↓ 2 Mt $CO_2$-e 2023 to 2030
↓ 3 Mt $CO_2$-e 2023 to 2035




Agriculture sector emissions relate to the biological processes associated with agricultural commodity production. This includes emissions from enteric fermentation (the production of methane through the digestive process of ruminant animals such as sheep and cattle), agricultural soils, manure management, liming and urea application, rice cultivation, and field burning of agricultural residues. The agriculture sector does not include emissions from energy used by farm machinery or electricity use, which are included in the stationary energy and electricity sectors.

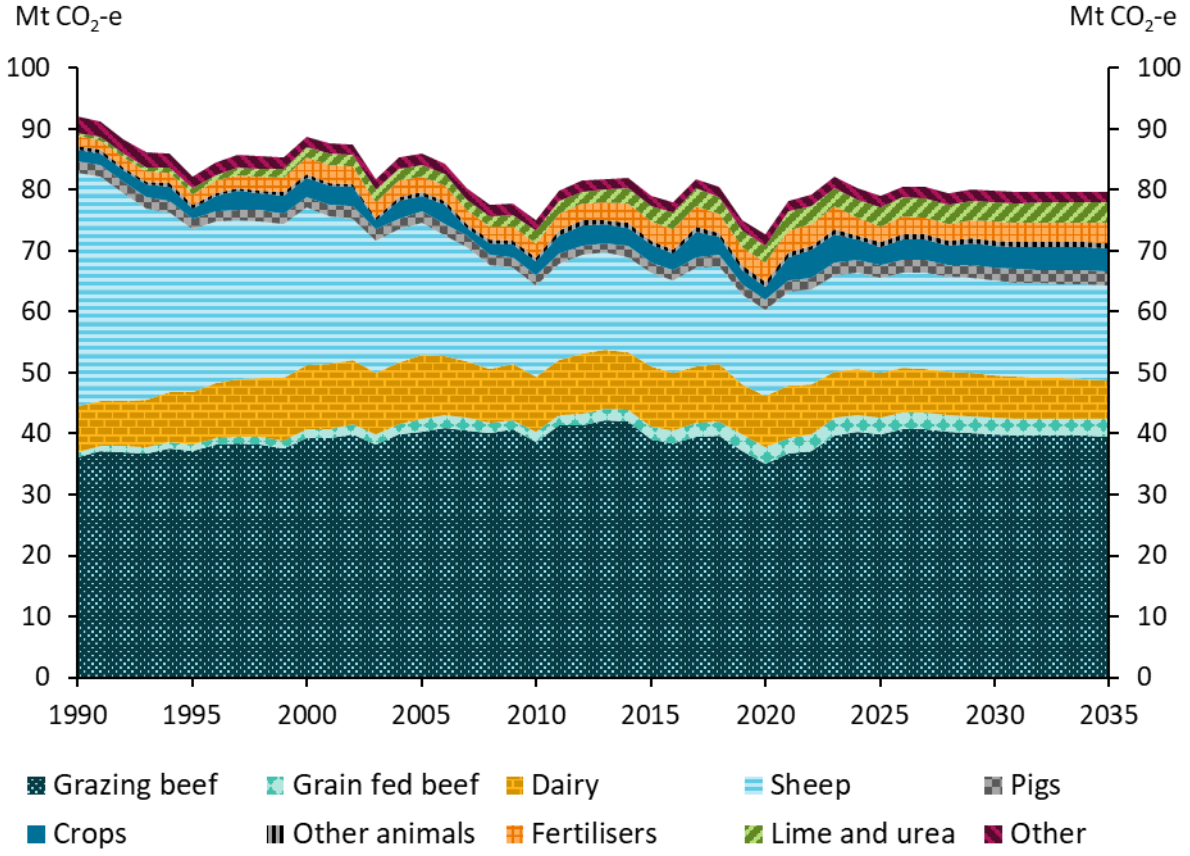
Most agricultural emissions are methane and nitrous oxide from livestock feed consumption and the decay or combustion of living and dead biomass, with small amounts of carbon dioxide emitted from the application of lime and urea.

**Table 29 Agriculture emissions in the baseline scenario, Mt $CO_2$-e**

| Emissions by subsector | 2005 | 2020 | 2025 | 2030 | 2035 |
|---|---|---|---|---|---|
| Grazing beef | 40 | 35 | 40 | 40 | 40 |
| Grain fed beef | 2 | 3 | 3 | 3 | 3 |
| Dairy | 11 | 9 | 7 | 7 | 6 |
| Sheep | 22 | 14 | 16 | 16 | 15 |
| Pigs | 2 | 2 | 2 | 2 | 2 |
| Other animals | 1 | 1 | 1 | 1 | 1 |
| Crops | 2 | 2 | 3 | 4 | 4 |
| Fertilisers | 3 | 3 | 3 | 3 | 3 |
| Lime and urea | 2 | 3 | 3 | 3 | 3 |
| Other | 2 | 2 | 2 | 2 | 2 |
| **Total** | **86** | **73** | **79** | **80** | **80** |

Note: totals may not sum due to rounding.

**Figure 28 Agriculture emissions in the baseline scenario, 1990 to 2035, Mt $CO_2$-e**




# Emissions trends in the baseline scenario

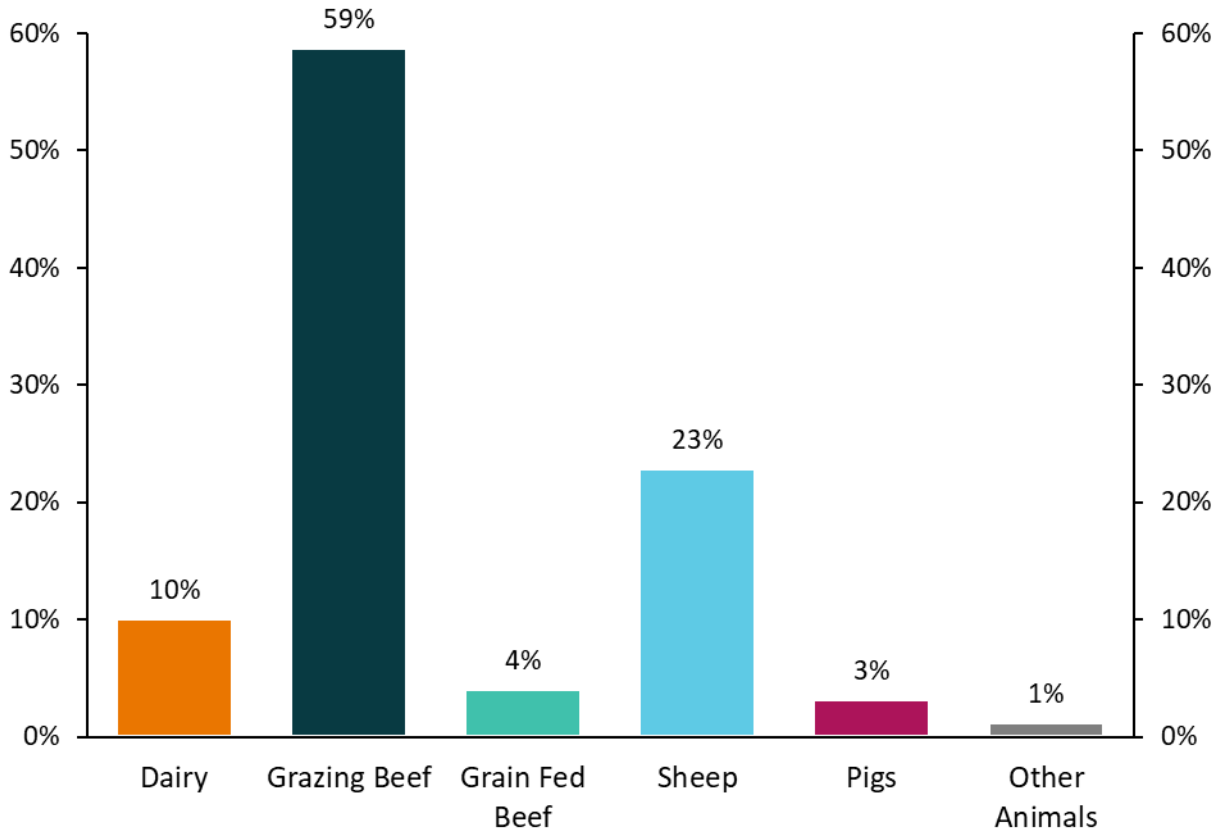
Agriculture emissions are estimated to be 82 Mt $CO_2$-e in 2023 and are projected to decrease by 3% to 80 Mt $CO_2$-e in 2030. Emissions are also projected to be 80 Mt $CO_2$-e in 2035, 3% below 2023 levels. Emissions from the agriculture sector were at a 17 year high in 2023 following three consecutive years of above-average rainfall driven by La Niña conditions. La Niña is associated with increased rainfall and cloudiness, which usually results in above-average winter-spring rainfall across the east and north of Australia. Drier conditions, which are forecast over the next five years are likely to limit crop production, increase livestock turnoff, and lead to an associated decline in emissions. Emissions in later years are modelled using a continuation of historical activity trends as well the impact of technological and policy changes. [57]

Enteric fermentation emissions from livestock accounted for the majority (69%) of agriculture emissions in 2023. Changes to enteric fermentation emissions are driven by changes to livestock numbers, the projected uptake of low-emissions feed supplements, and the participation of livestock farmers in the ACCU Scheme. Figure 29 shows the projected proportion of livestock emissions by commodity in 2030, with grazing beef producing 59% of all livestock emissions.

[57] Short and medium-term growth rates are based on ABARES Agricultural commodity forecasts where available. Long-term growth rates are largely based on historical trends. More information is available in the *Methodology for the 2023 Projections* report on the department's website.

Low emissions feed supplements such as asparagopsis and the compound 3-NOP are expected to be introduced gradually to grain fed beef cattle, grazing beef cattle, dairy cattle, and sheep in the coming years as the technology matures and manufacturing capacity increases. These feed supplements can be added to livestock feed to decrease the amount of methane produced through enteric fermentation. This is projected to have the greatest impact on emissions from grain fed cattle, as the supplements can be delivered most effectively in feedlots. Annual abatement from feed supplements is projected to be 0.6 Mt $CO_2$-e in 2030 and 1.6 Mt $CO_2$-e in 2035.

**Figure 29 2030 livestock emissions, commodity categories, %**




Note: totals may not sum due to rounding.

## Livestock trends

Livestock activity has a strong dependence on short-term climate variations. High rainfall throughout much of 2021 and 2022 as a result of La Niña has led to greater pasture availability and widespread restocking of grazing livestock, increasing livestock emissions. Conversely, lower rainfall over the next five years is projected to decrease livestock activity and the associated emissions overall.

Grazing beef cattle are projected to remain the largest contributor to agricultural emissions throughout the projections period. Grazing beef cattle produced 40 Mt $CO_2$-e in 2023, 5 Mt $CO_2$-e higher than 2020 when drought restricted grazing cattle numbers. Emissions are projected to peak at 41 Mt $CO_2$-e in 2026 and 2027, before decreasing to 40 Mt $CO_2$-e in 2030 and 2035. Grain fed beef cattle activity is projected to continue increasing, following the historical trend towards a greater proportion of beef cattle spending longer in feedlots. However, emissions are projected to stabilise at less than 3 Mt $CO_2$-e from 2023 onwards as the projected uptake of low emissions feed supplements offsets the increased activity in this sector.

Emissions from sheep are projected to be 2% lower in 2030 and 2035 than in 2023. Dairy cattle emissions are projected to decline from 8 Mt $CO_2$-e in 2023 to 7 Mt $CO_2$-e in 2030 and 6 Mt $CO_2$-e in 2035. Although activity in both sectors is projected to be relatively constant in later years, emissions will continue to decline as the introduction of low emissions feed supplements decreases the amount of methane emitted per head, especially for dairy cattle.

Emissions from pigs and poultry are projected to increase between 2023 and 2035, driven by increasing activity due to strong domestic demand and the relative robustness of intensive livestock industries to poor seasonal conditions and higher feed prices.[58] The 'other animals' subsector includes emissions from poultry and range-fed livestock (goats, horses, deer, buffalo, donkeys, emus and camels). With the exception of poultry, activity of these livestock is held constant due to limited data on growth potential.

### Crop trends

Emissions from crops in 2023 were 5 Mt $CO_2$-e, the highest point since the start of the inventory in 1990. Between 2023 and 2025, crop emissions are projected to decline by 35% as crop production declines from record highs due to drier seasonal conditions. In particular, production of some of Australia's most significant crops (wheat, barley, and canola) is forecast to fall by more than 30% in 2023-24.[59] From 2024 to 2028, the projection of crop emissions is based on the Australian Bureau of Agricultural Resource Economics and Science (ABARES) 5-year agricultural commodity forecasts, which show mixed levels of activity as crop production is heavily dependent on forecast seasonal conditions in each cropping zone. From 2029 onwards, crop projections are based on historical trends. Crop emissions are projected to be 23% and 18% lower in 2030 and 2035 respectively than in 2023.

## Comparison to previous projections

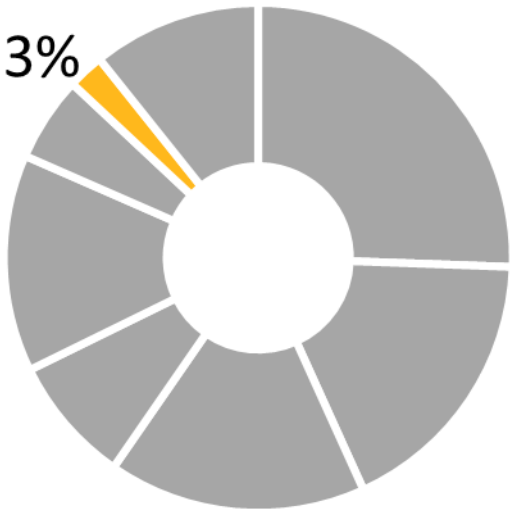
Compared with the previous projections, emissions are projected to be 1 Mt $CO_2$-e higher in 2030 and 2035. This is partly due to a higher starting point in 2023 associated with higher than expected crop production and livestock activity. Activity forecasts have been updated since the previous projections, which results in higher emissions in some years and lower emissions in others.

[58] ABARES 2023, Agricultural Commodities Report: March quarter 2023, Australian Bureau of Agricultural Resource Economics and Science, Canberra, DOI: 10.25814/5d9165cf4241d

[59] ABARES 2023, Agricultural Commodities Report: June quarter 2023, Australian Bureau of Agricultural Resource Economics and Science, Canberra, DOI: 10.25814/5d9165cf4241d

# Waste

3% of Australia's emissions in 2023
↓ <1 Mt $CO_2$-e 2023 to 2030
↓ <1 Mt $CO_2$-e 2023 to 2035




The waste sector covers emissions from: the disposal of organic materials to landfill; wastewater emissions from domestic, commercial, and industrial sources; the biological treatment of solid waste; and clinical and solvent waste incineration. Emissions are mostly methane generated from the anaerobic decomposition of organic matter. Small amounts of carbon dioxide and nitrous oxide are also generated by incineration and the decomposition of human waste.

**Table 30 Waste emissions in the baseline scenario, Mt $CO_2$-e**

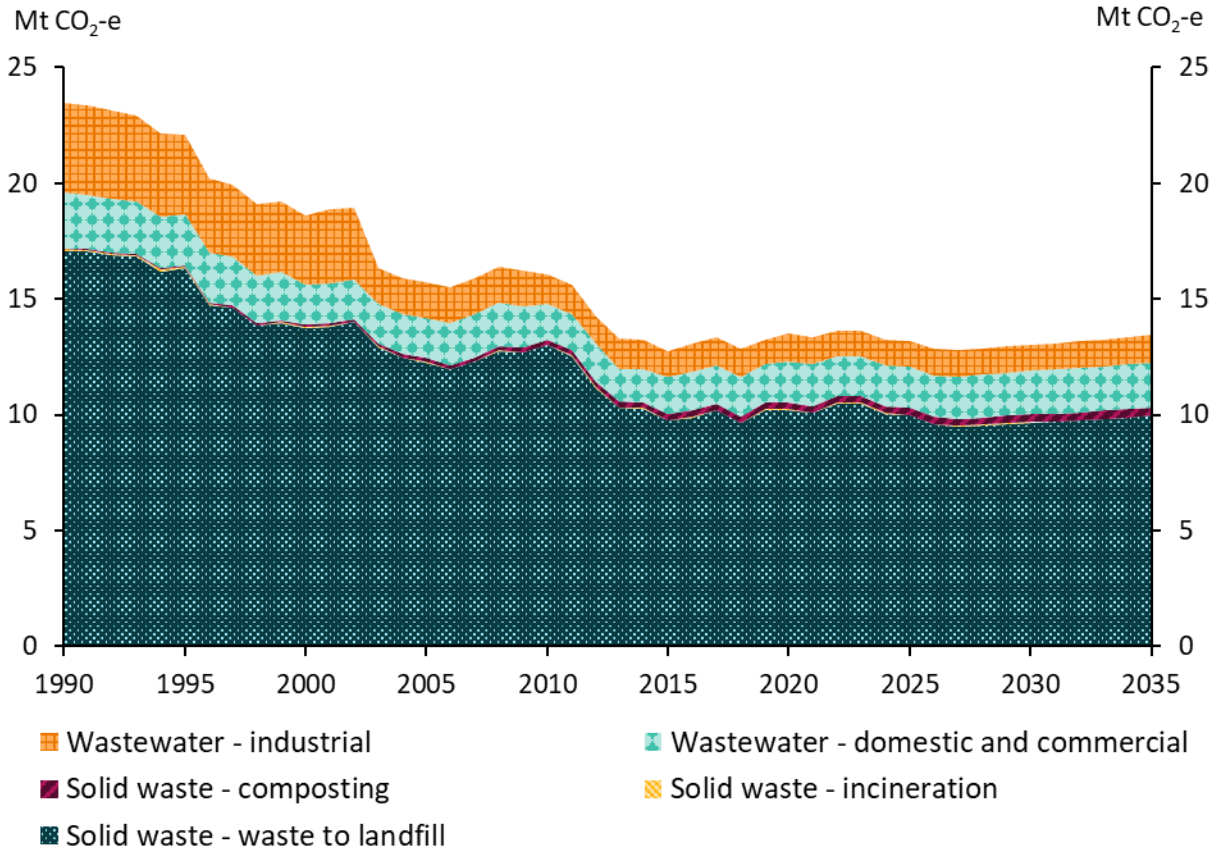
| Emissions by subsector | 2005 | 2020 | 2025 | 2030 | 2035 |
|---|---|---|---|---|---|
| Solid waste to landfill | 12 | 10 | 10 | 10 | 10 |
| Solid waste – composting | <1 | <1 | <1 | <1 | <1 |
| Incineration | <1 | <1 | <1 | <1 | <1 |
| Domestic and commercial wastewater | 2 | 2 | 2 | 2 | 2 |
| Industrial wastewater | 2 | 1 | 1 | 1 | 1 |
| **Total** | **16** | **13** | **13** | **13** | **13** |

Note: totals may not sum due to rounding.

## Emissions trends in the baseline scenario

Waste emissions are estimated to be 13.6 Mt $CO_2$-e in 2023 and are projected to decrease by 4% to 13.0 Mt $CO_2$-e in 2030. From 2023 to 2035 emissions decline by 1% to 13.5 Mt $CO_2$-e in 2035. This trend is primarily driven by declining emissions in the solid waste to landfill sector.

**Figure 30 Waste emissions in the baseline scenario, 1990 to 2035, Mt $CO_2$-e**



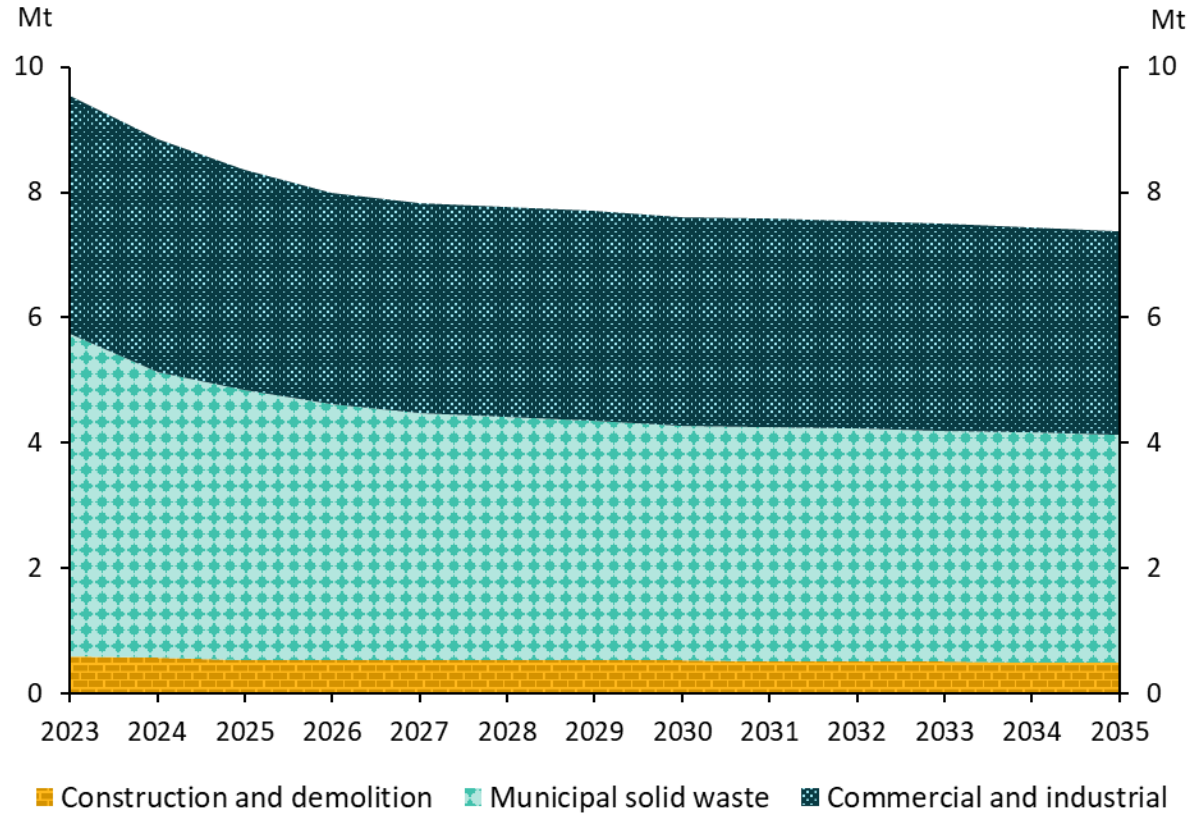

## Solid waste trends

The landfill sector is the largest contributor to waste emissions. It produced 10.5 Mt $CO_2$-e in 2023, which is projected to decline by 1 Mt $CO_2$-e to a low in 2027, before increasing slightly between 2028 and 2035. This trend is mainly driven by population growth partially offsetting improvements in waste diversion, as well as declining abatement from waste ACCU projects.

Waste deposited in landfills is classified according to three waste streams: municipal solid waste, commercial and industrial waste, and construction and demolition waste. Each of these streams is further disaggregated into a mix of individual waste categories: food, paper and cardboard, garden and park, wood, textiles, sludge (including biosolids), nappies, rubber and leather, and inert (concrete, metal, plastics, glass, soil etc.). All of these waste categories produce emissions when in landfill and are modelled in the projections, with the exception of inert waste. The amount of non-inert waste deposited in landfills is projected to decline across all three waste streams from 2023 to 2035 (Figure 31).

The projections model the amount of each category of non-inert waste deposited in landfills. The amount of waste generated is generally projected to grow with population, while the proportion of each waste category sent to landfill is adjusted to account for policies and trends within the sector. For example, many jurisdictions plan to introduce Food Organics and Garden Organics bins for households, which will divert substantial quantities of food and garden waste from landfill. As these make up around 70% of non-inert waste currently deposited in landfills (Figure 32), this is projected to significantly decrease landfill emissions. The projections also account for the impact of projects funded through the Recycling Modernisation Fund and approved Energy from Waste projects.

**Figure 31 Non-inert waste deposited at landfills, by stream, 2023 to 2035, Mt**




Most existing waste projects under the ACCU Scheme are scheduled to end by 2035. As these projects end, Blue Environment advised that it is likely that the abatement they generate will not continue in full, because landfill gas collection requires ongoing bore installation and equipment maintenance which may not continue in the absence of additional funding.[60] Therefore, a decline in abatement from waste ACCU projects somewhat offsets the smaller amount of waste deposited to landfill. These projections may be impacted by the outcomes of reforms to the landfill ACCU methods which are still ongoing. The reforms to the Safeguard Mechanism contribute a small amount of abatement in the landfill sector from process efficiency improvements.

## Wastewater trends

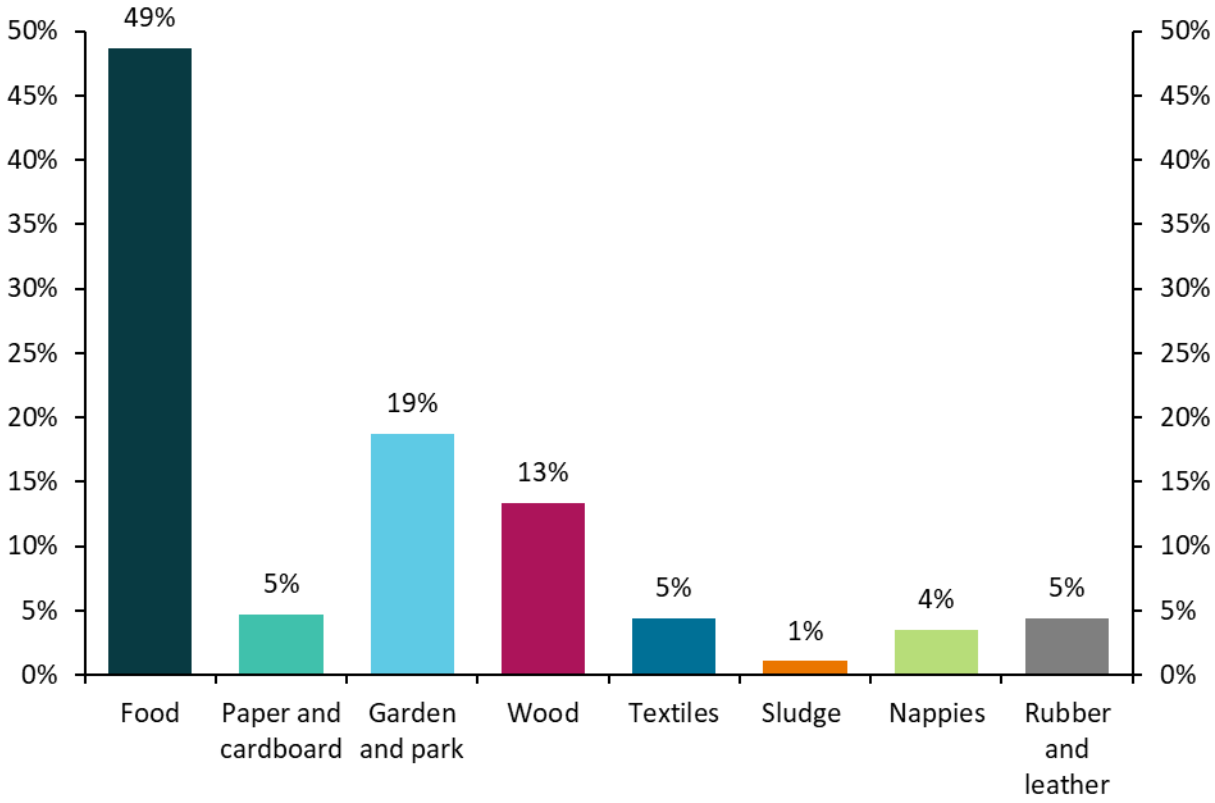
Domestic and commercial wastewater emissions result from the anaerobic decomposition of organic matter in sewerage facilities, as well as some emissions from areas not connected to sewerage systems. Emissions in this sector are projected to increase gradually in line with population. This increase is mitigated slightly by small projected increases in the proportion of the population connected to sewerage systems, as sewage emits less when processed in municipal wastewater facilities. The reforms to the Safeguard Mechanism contribute a small amount of abatement in the domestic and commercial wastewater sector from process efficiency improvements.

Emissions from industrial wastewater come from the decomposition of organic matter from industrial production processes such as the production of beer, meat, and organic chemicals.

[60] Blue Environment 2023, Waste Emissions Projections 2023, Department of Climate Change, Energy, the Environment, and Water

Emissions from this sector are projected to remain relatively unchanged from 2023 to 2035, with small increases in response to changes in commodity production levels.

**Figure 32 Non-inert waste deposited at landfills in 2023, by commodity, %**



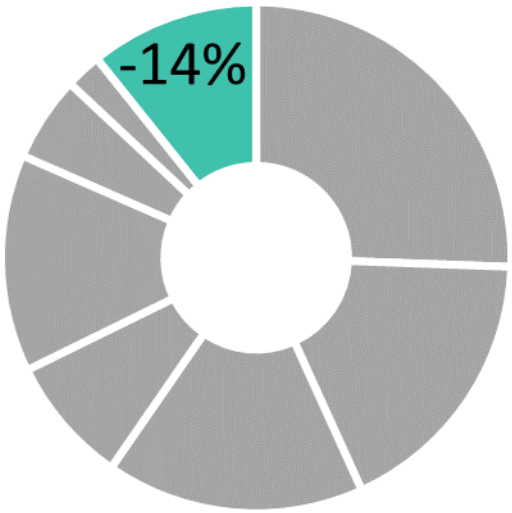

# Comparison to previous projections

Compared with the previous projections, emissions are projected to be 2 Mt $CO_2$-e higher in 2030 and 4 Mt $CO_2$-e higher in 2035. Compared with the previous projections, waste emissions are 1 Mt $CO_2$-e higher in 2023 due to revisions made to the way the National Greenhouse Gas Inventory estimates residual disposal and capture from landfills.[61] The increase in emissions in the 2023 projections compared with last year reflects the higher starting point in 2023. There is also an improvement to the solid waste sector methodology so that it no longer uses specific targets such as the National Food Waste Strategy target and resource recovery targets to drive emissions outcomes. Instead, the amount of each waste type deposited to landfill is modelled individually based on policies and expected trends. It also reflects updated ACCU modelling, which projects lower than previously projected abatement from ACCU projects in the waste sector.

[61] DCCEEW 2023, National Inventory Report Volume I, Department of Climate Change, Energy, the Environment and Water, accessed 13 October 2023

# Land use, land use change and forestry

-14% (net sink equivalent)
of Australia's emissions in 2023
↑ 7 Mt $CO_2$-e 2023 to 2030
↑ 8 Mt $CO_2$-e 2023 to 2035




The LULUCF sector includes both sources of greenhouse gas emissions and sinks that remove carbon dioxide from the atmosphere and sequester it as carbon in living biomass, debris, and soils. Changes to land management practices have had significant impacts on Australia's vegetation since 1990. Reductions in vegetation clearing, especially primary forest clearing (clearing of forest that has not been previously cleared), the fostering of vegetation growth, and the use of shelter belts have all contributed to improved carbon stock outcomes in Australia's forests and on Australia's grazing lands.

The LULUCF sector projections are based on the UNFCCC inventory structure as described in Australia's National Inventory Report 2021. The major land categories used include:

• **Forest land**, including forest land remaining forest land (harvested native forests, pre-1990 plantations, wildfires and prescribed burns, and fuelwood) and land converted to forest land (hard and softwood plantations, environmental plantings, natural regeneration, regrowth on previously cleared land, controlled burns and wildfire).

• **Cropland**, including cropland remaining cropland (changes in soil carbon under herbaceous crops and woody horticulture) and land converted to cropland (forests and wetlands).

• **Grasslands**, including grassland remaining grassland (changes in soil carbon through pastoral activities, fire management in savanna rangelands, and changes in shrubby vegetation extent on grasslands) and land converted to grassland (forest and wetlands).

• **Wetlands**, including wetland remaining wetland (flooded lands, other wetlands, aquaculture activities, dredging of seagrasses, and mangrove and tidal marsh conversions) and land converted to wetland (forests and reservoirs).

• **Settlement**s, including settlements remaining settlements (sparse woody vegetation) and land converted to settlements (forests).

• **Harvested wood products**, including paper, solid wood, and wood products waste.

# Emissions trends in the baseline scenario

LULUCF emissions have decreased since 1990, reaching -64 Mt $CO_2$-e in 2023. As shown in Figure 33, the sector is expected to remain a net sink with emissions projected to be -57 Mt $CO_2$-e in 2030 and -56 Mt $CO_2$-e in 2035. In the near-term emissions will rise slightly as La Nina-driven post-drought recovery ends, and later stabilise as reductions in native forest harvesting, continued lower land clearing and ACCUs generated under the ACCU Scheme continue to take effect.

**Figure 33 Emissions and removals from LULUCF in the baseline scenario, 1990 to 2035, Mt $CO_2$-e**

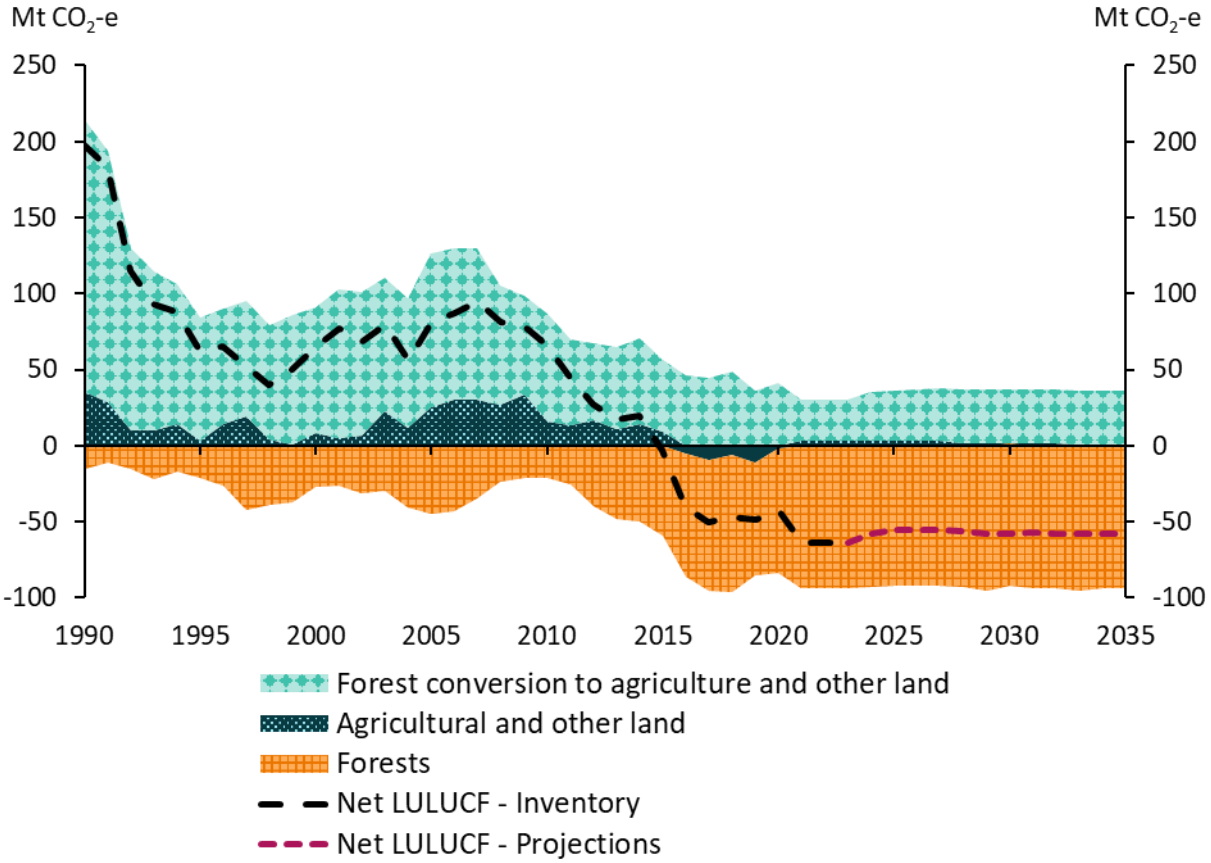



**Table 31 LULUCF emissions in the baseline scenario, Mt $CO_2$-e**

| Emissions by subsector | 2005 | 2020 | 2025 | 2030 | 2035 |
|---|---|---|---|---|---|
| Forests | -45 | -82 | -92 | -94 | -92 |
| Agricultural and other lands | 25 | -2 | 3 | 2 | 1 |
| Forest conversions to Agricultural and other lands | 101 | 41 | 33 | 35 | 35 |
| **Total** | **81** | **-43** | **-55** | **-57** | **-56** |

## Forests

The forest category includes forest land remaining forest land, land converted to forest and harvested wood products. Forest land remaining forest land will see continued gains in the net sink in harvested native forests, particularly through the cessation of native forest logging in Victoria and Western Australia from 1 January 2024, as well as replanting of pre-1990 plantations. Land converted

to forest land emissions will increase slightly above current historic lows as the plantation harvest-cycle continues and La Nina-driven gains in regrowth and regeneration ends. Carbon sequestration projects under the ACCU Scheme are also reflected in the projections. Harvested wood products are expected to continue at current levels as a net sink.

This category is subject to bushfires which can release significant amounts of carbon dioxide. In the years following fire, vegetation generally recovers generating a significant carbon sink. The approach adopted by the projections is consistent with Australia's national greenhouse gas inventory and includes anthropogenic and non-anthropogenic fires. For the latter, which arise from natural disturbances, the carbon stock loss from the fire event as well as the subsequent recovery are modelled to average out over time. This leaves greenhouse gas emissions and removals from anthropogenic fires as the dominant result.

### Agricultural and other lands

This includes cropland remaining cropland, grassland remaining grassland, wetland remaining wetland, and settlements remaining settlements. This category is sensitive to climatic variability and became a source of emissions in 2021. This trend is expected to continue over the projection period although with a slight decline due to abatement from ACCUs generated from agricultural carbon farming projects to 2035.

### Forest conversions to agricultural and other lands

This category includes land converted to cropland, grassland, wetland, and settlements. Historically this has been the largest source of emissions in the LULUCF sector through the loss of vegetation, burning of residues and decay of soil when land is cleared. Most forest conversion activity in Australia is to provide pastures for grazing activities, although some forest conversion occurs to support cropping, settlements, infrastructure, and reservoirs.

Australia's remote sensing program published in the 2021 National Inventory Report found that land clearing activity, and resulting emissions, fell to record low levels in 2021 and strong post-drought recovery during La Nina, increased the size of the sink. The 2023 projection assumes no significant upward trend in clearing areas, especially primary clearing, which generates most emissions in this sector. Therefore, emissions are expected to remain fairly constant into the future, slightly above current levels.

## Comparison to previous projections

Compared with the previous projections, the LULUCF sink is projected to be 24 Mt $CO_2$-e larger in 2030 and 12 Mt $CO_2$-e larger in 2035. These changes are driven by the starting base of a higher net sink in the updated National Greenhouse Gas Inventory, the impact of updated state policies around native forest harvesting, and other updates including higher estimates of ACCU supply.

# Emissions projections by gas

Australia's emissions projections are prepared by gas and by sector. As greenhouse gases vary in their radiative activity and in their atmospheric residence time, converting emissions into $CO_2$-e allows for the integrated effect of emissions of the various gases to be compared.[62]

Of the greenhouse gases, carbon dioxide accounts for by far the largest share of emissions. In the baseline, carbon dioxide emissions are projected to decline by 46% between 2023 and 2035, from 309 Mt $CO_2$-e in 2023 to 232 Mt $CO_2$-e in 2030 and 167 Mt $CO_2$-e in 2035. In the 'with additional measures' scenario carbon dioxide emissions are projected to decline by 53% between 2023 and 2035 declining to 204 Mt $CO_2$-e in 2030 and 146 Mt $CO_2$-e in 2035. The major sources of carbon dioxide in Australia are the electricity, transport and stationary energy sectors which are all projected to decline to 2035. The LULUCF sector is a source of carbon dioxide emissions as well as a sink that removes carbon dioxide from the atmosphere. The largest decline in carbon dioxide emissions is a result of strong uptake of renewables reducing emissions in the electricity sector.

Methane emissions are projected to be relatively stable, increasing from 123 Mt $CO_2$-e in 2023 to 125 Mt $CO_2$-e in 2030 and 120 Mt $CO_2$-e in 2035 in the baseline and 'with additional measures' scenarios. Fugitive methane emissions from fossil fuel extraction are projected to decline as companies covered by the Safeguard Mechanism undertake abatement activities while methane emissions from other major sources including agriculture and waste are largely unchanged to 2035.

Emissions from HFCs are projected to decline by 45%, from 11 Mt $CO_2$-e in 2023 to 8 Mt $CO_2$-e in 2030 and 6 Mt $CO_2$-e in 2035 in the baseline and 'with additional measures' scenarios. The decline is due to the *Ozone Protection and Synthetic Greenhouse Gas Management Act 1989* and associated regulations which legislate an annual import quota on bulk imports of HFCs. HFCs are used in air conditioners, refrigeration, foam blowing, aerosols, and fire protection equipment.

**Table 32 Emissions projections by gas in the baseline scenario, Mt $CO_2$-e**

| Emissions projections by gas | 2005 | 2020 | 2025 | 2030 | 2035 |
|---|---|---|---|---|---|
| Carbon dioxide ($CO_2$) | 444 | 340 | 297 | 232 | 167 |
| Methane ($CH_4$) | 145 | 123 | 126 | 125 | 120 |
| Nitrous oxide ($N_2O$) | 22 | 20 | 19 | 20 | 20 |
| Hydrofluorocarbons (HFCs) | 4 | 11 | 10 | 8 | 6 |
| Perfluorocarbons (PFCs) | 2 | <1 | <1 | <1 | <1 |
| Sulphur hexafluoride ($SF_6$) | <1 | <1 | <1 | <1 | <1 |
| **Total** | **616** | **494** | **452** | **386** | **313** |

Note: totals may not sum due to rounding; Australia's emissions of nitrogen trifluoride ($NF_3$) are considered negligible and are not estimated.

[62] The Department applied the 100-year global warming potential values from the IPCC Fifth Assessment Report (AR5) to estimate emissions, consistent with rules adopted under the Paris Agreement (Decision 18/CMA.1 Annex 2.D Paragraph 37).

## Table 33 Emissions projections by gas in the 'with additional measures' scenario, Mt $CO_2$-e

| Emissions projections by gas | 2005 | 2020 | 2025 | 2030 | 2035 |
|---|---|---|---|---|---|
| Carbon dioxide ($CO_2$) | 444 | 340 | 297 | 204 | 146 |
| Methane ($CH_4$) | 145 | 123 | 126 | 125 | 120 |
| Nitrous oxide ($N_2O$) | 22 | 20 | 19 | 20 | 20 |
| Hydrofluorocarbons (HFCs) | 4 | 11 | 10 | 8 | 6 |
| Perfluorocarbons (PFCs) | 2 | <1 | <1 | <1 | <1 |
| Sulphur hexafluoride ($SF_6$) | <1 | <1 | <1 | <1 | <1 |
| **Total** | **616** | **494** | **452** | **358** | **292** |

Note: totals may not sum due to rounding; Australia's emissions of nitrogen trifluoride ($NF_3$) are considered negligible and are not estimated.

## Table 34 Carbon dioxide ($CO_2$) emissions projections by sector in the baseline scenario, Mt $CO_2$-e

| $CO_2$ Emissions projections | 2005 | 2020 | 2025 | 2030 | 2035 |
|---|---|---|---|---|---|
| Electricity | 196 | 171 | 131 | 81 | 37 |
| Stationary energy | 80 | 98 | 100 | 95 | 82 |
| Transport | 80 | 92 | 101 | 100 | 94 |
| Fugitives | 7 | 17 | 16 | 12 | 10 |
| Industrial processes and product use | 22 | 19 | 18 | 15 | 13 |
| Agriculture | 2 | 3 | 3 | 3 | 3 |
| Waste | <1 | <1 | <1 | <1 | <1 |
| Land use, land-use change and forestry | 57 | -59 | -72 | -74 | -73 |
| **Total** | **444** | **340** | **297** | **232** | **167** |

Note: totals may not sum due to rounding.

## Table 35 Carbon dioxide ($CO_2$) emissions projections by sector in the 'with additional measures' scenario, Mt $CO_2$-e

| $CO_2$ Emissions projections | 2005 | 2020 | 2025 | 2030 | 2035 |
|---|---|---|---|---|---|
| Electricity | 196 | 171 | 131 | 60 | 32 |
| Stationary energy | 80 | 98 | 100 | 95 | 82 |
| Transport | 80 | 92 | 101 | 93 | 79 |
| Fugitives | 7 | 17 | 16 | 12 | 10 |
| Industrial processes and product use | 22 | 19 | 18 | 15 | 13 |
| Agriculture | 2 | 3 | 3 | 3 | 3 |
| Waste | <1 | <1 | <1 | <1 | <1 |
| Land use, land-use change and forestry | 57 | -59 | -72 | -74 | -73 |
| **Total** | **444** | **340** | **297** | **204** | **146** |

## Table 36 Methane ($CH_4$) emissions projections by sector in the baseline and 'with additional measures' scenario, Mt $CO_2$-e

| $CH_4$ Emissions projections | 2005 | 2020 | 2025 | 2030 | 2035 |
|---|---|---|---|---|---|
| Electricity | <1 | <1 | <1 | <1 | <1 |
| Stationary energy | 2 | 1 | 1 | 1 | 1 |
| Transport | 1 | <1 | <1 | <1 | <1 |
| Fugitives | 36 | 36 | 34 | 34 | 29 |
| Industrial processes and product use | <1 | <1 | <1 | <1 | <1 |
| Agriculture | 72 | 58 | 64 | 64 | 63 |
| Waste | 15 | 13 | 13 | 13 | 13 |
| Land use, land-use change and forestry | 19 | 13 | 13 | 14 | 14 |
| Total | **145** | **123** | **126** | **125** | **120** |

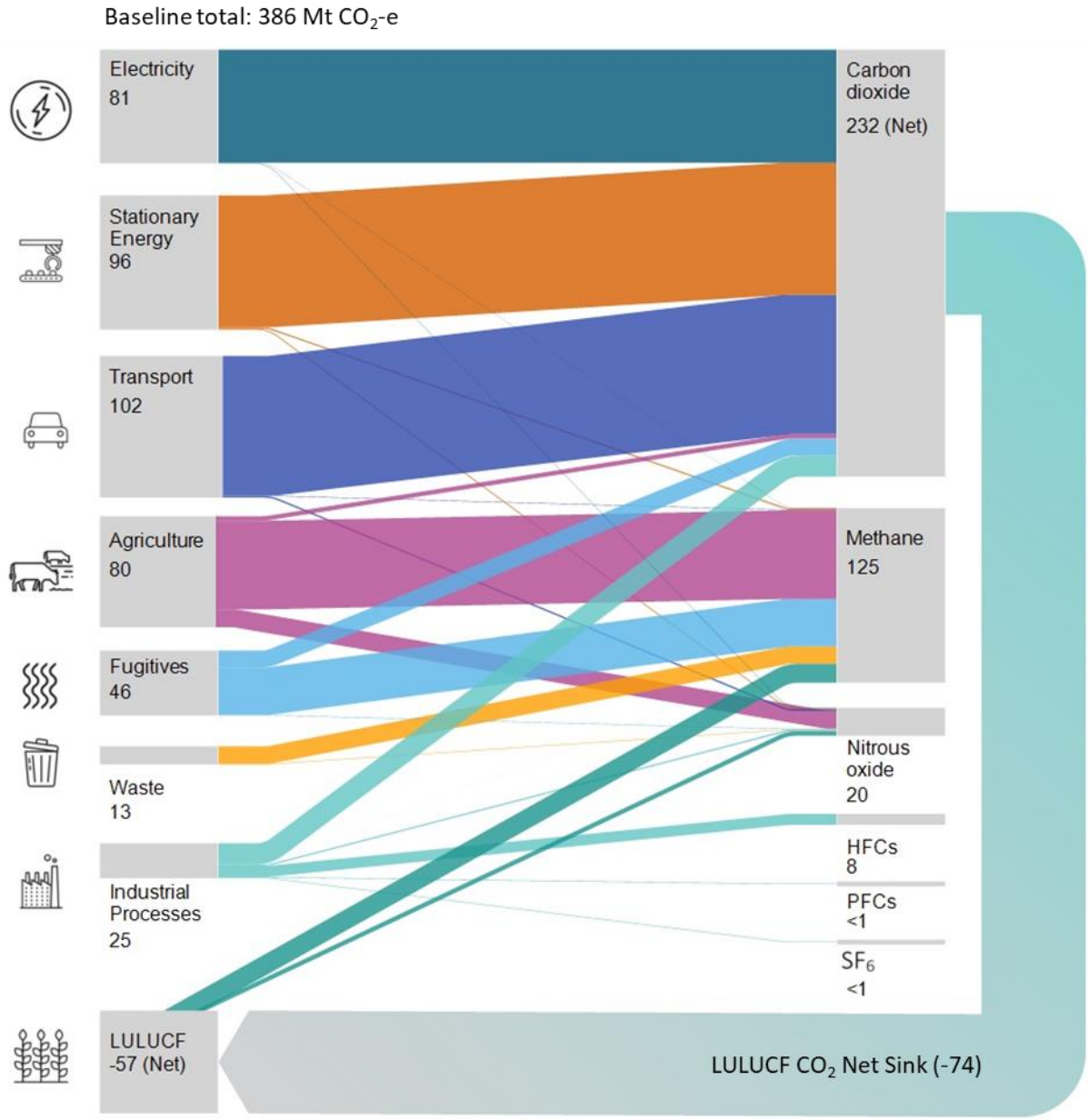
Note: totals may not sum due to rounding.

## Table 37 Nitrous oxide ($N_2O$) emissions projections by sector in the baseline and 'with additional measures' scenario, Mt $CO_2$-e

| $N_2O$ Emissions projections | 2005 | 2020 | 2025 | 2030 | 2035 |
|---|---|---|---|---|---|
| Electricity | 1 | 1 | <1 | <1 | <1 |
| Stationary energy | 1 | 1 | 1 | 1 | 1 |
| Transport | 2 | 1 | 1 | 1 | 1 |
| Fugitives | <1 | <1 | <1 | <1 | <1 |
| Industrial processes and product use | 2 | 2 | 1 | 1 | 1 |
| Agriculture | 12 | 12 | 12 | 13 | 13 |
| Waste | <1 | <1 | <1 | <1 | <1 |
| Land use, land-use change and forestry | 4 | 3 | 3 | 3 | 3 |
| Total | **22** | **20** | **19** | **20** | **20** |

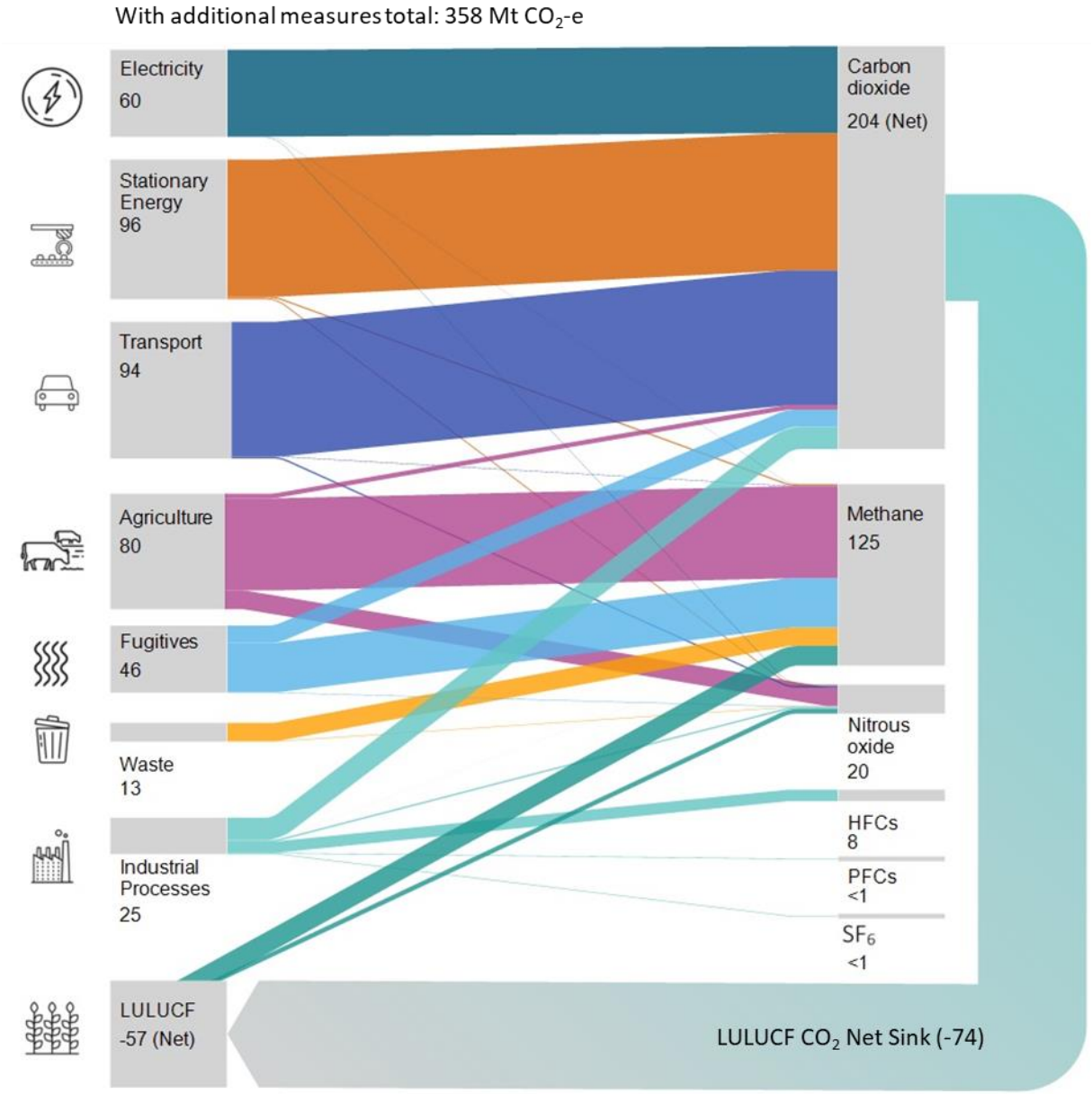
Note: totals may not sum due to rounding.

**Figure 34 Australia's emissions projections by gas in the baseline scenario, 2030, Mt $CO_2$-e**




Note: totals may not sum due to rounding.

**Figure 35 Australia's emissions projections by gas in the 'with additional measures' scenario, 2030, Mt $CO_2$-e**




Note: totals may not sum due to rounding.

# Emissions projections by economic sector

## Introduction

The emissions projections are prepared under the UNFCCC reporting rules. The categories used in UNFCCC reporting are the IPCC categories, which relate to the direct processes that produce emissions, such as methane produced from the digestion process of animals in the agriculture sector. The IPCC categories are used to present the results in the main body of this report.

This section provides an alternative presentation by disaggregating emissions by ANZSIC which may be more familiar for some readers. These classifications relate to recognisable industries and business activities, such as mining. The results are presented for both the baseline and 'with additional measures' scenarios.

## Direct emissions (scope 1 emission) trends

Table 38 shows that, on an ANZSIC basis, the electricity, gas and water sector and the primary industries sector are the largest sources of emissions in the baseline scenario. The electricity, gas and water sector is projected to decline from 157 Mt $CO_2$-e in 2023 to 49 Mt $CO_2$-e in 2035 in the baseline scenario and 45 Mt $CO_2$-e in the 'with additional measures' scenario. Emissions from the electricity, gas and water sector are mostly due to the combustion of fossil fuels at power stations to produce electricity.

Emissions from agriculture, forestry and fishing are projected to remain relatively unchanged at current levels, increasing from 40 Mt $CO_2$-e in 2023 to 43 Mt $CO_2$-e in 2030 and 44 Mt $CO_2$-e in 2035 in the baseline and 'with additional measures' scenarios. The largest drivers of this sector are enteric fermentation emissions from cows and sheep and emissions from land management. Land management emissions are projected to increase in the near term as the recent elevated levels of sequestration supported by wetter La Nina conditions ends.

Emissions from mining are projected to decline by around 25% from 100 Mt $CO_2$-e in 2023 to 75 Mt $CO_2$-e in 2035 in the baseline scenario and 'with additional measures' scenarios. Emissions are projected to decline due to increased electrification and reduced consumption of diesel across all mining equipment categories and reduced fugitive emissions due to lower coal production and abatement activities at coal mines and oil and gas facilities.

Despite declining emissions from the mining sector, the primary industries emissions share of total emissions is projected to grow from 30% of total emissions in 2023 to 38% in 2035 in the baseline scenario and 40% in the 'with additional measures' scenario, due to more rapid decarbonisation of other sectors, in particular electricity generation.

Emissions from manufacturing are projected to decline from 57 Mt $CO_2$-e in 2023 to 42 Mt $CO_2$-e in 2035 in the baseline and 'with additional measures' scenario as companies are incentivised to take up a range of abatement opportunities, in part due to the Safeguard Mechanism.

Emissions from the residential and services, construction and transport sectors are projected to decline, largely due to electrification and reduced emissions from light duty vehicles due to increased uptake of EVs and more efficient ICE vehicles. Emissions are projected to decline even further in the 'with additional measures' scenario.

**Table 38 Emissions projections by economic sector in the baseline scenario, Mt $CO_2$-e**

| Emissions by economic sector | 2005 | 2020 | 2025 | 2030 | 2035 |
|---|---|---|---|---|---|
| Primary Industries | 230 | 151 | 144 | 134 | 119 |
| Agriculture, forestry and fishing | 169 | 45 | 43 | 43 | 44 |
| Mining | 60 | 107 | 101 | 91 | 75 |
| Coal Mining | 36 | 40 | 39 | 37 | 30 |
| Oil and gas extraction | 16 | 50 | 46 | 40 | 35 |
| Metal ore and non-metallic mineral mining and quarrying | 8 | 17 | 17 | 14 | 10 |
| Manufacturing | 73 | 57 | 56 | 51 | 42 |
| Electricity, gas and water | 211 | 175 | 137 | 90 | 49 |
| Services, construction and transport | 43 | 50 | 51 | 49 | 46 |
| Residential | 61 | 61 | 64 | 61 | 56 |
| **Total** | **616** | **494** | **452** | **386** | **313** |

Note: totals may not sum due to rounding.

**Table 39 Emissions projections by economic sector in the 'with additional measures' scenario, Mt $CO_2$-e**

| Emissions by economic sector | 2005 | 2020 | 2025 | 2030 | 2035 |
|---|---|---|---|---|---|
| Primary Industries | 230 | 151 | 144 | 132 | 118 |
| Agriculture, forestry and fishing | 169 | 45 | 43 | 43 | 44 |
| Mining | 60 | 107 | 101 | 89 | 75 |
| Coal Mining | 36 | 40 | 39 | 37 | 30 |
| Oil and gas extraction | 16 | 50 | 46 | 39 | 35 |
| Metal ore and non-metallic mineral mining and quarrying | 8 | 17 | 17 | 13 | 9 |
| Manufacturing | 73 | 57 | 56 | 51 | 42 |
| Electricity, gas and water | 211 | 175 | 137 | 70 | 45 |
| Services, construction and transport | 43 | 50 | 51 | 47 | 41 |
| Residential | 61 | 61 | 64 | 57 | 46 |
| **Total** | **616** | **494** | **452** | **358** | **292** |

Note: totals may not sum due to rounding.

**Figure 36 Emissions projections by economic sector in the baseline scenario, 2023 to 2035, Mt $CO_2$-e**

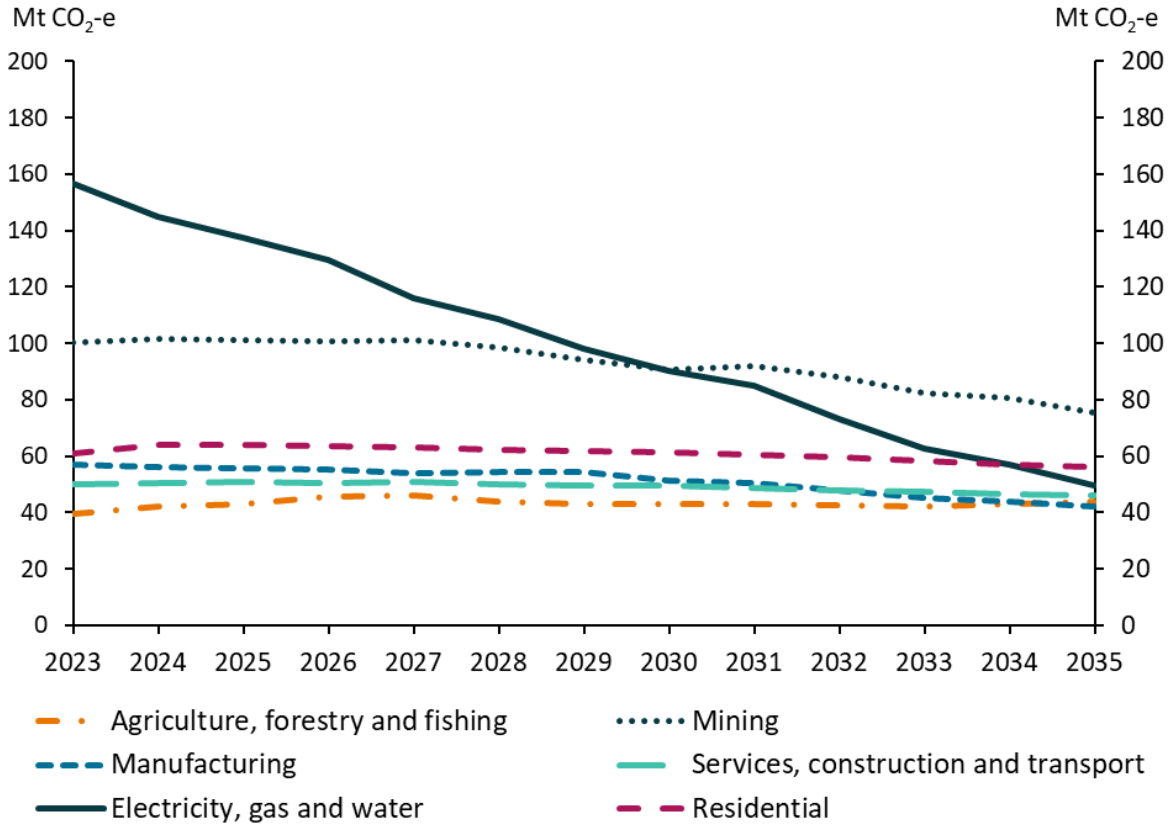



**Figure 37 Emissions projections by economic sector in the 'with additional measures' scenario, 2023 to 2035, Mt $CO_2$-e**

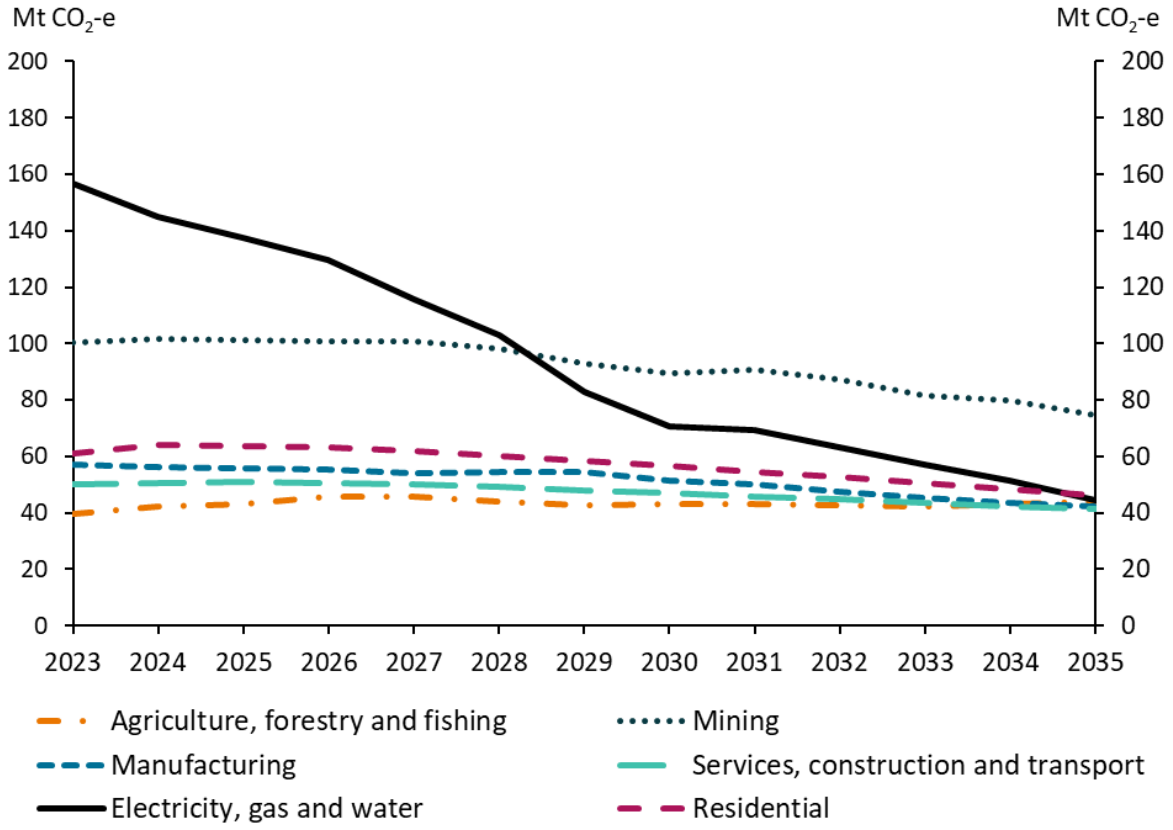
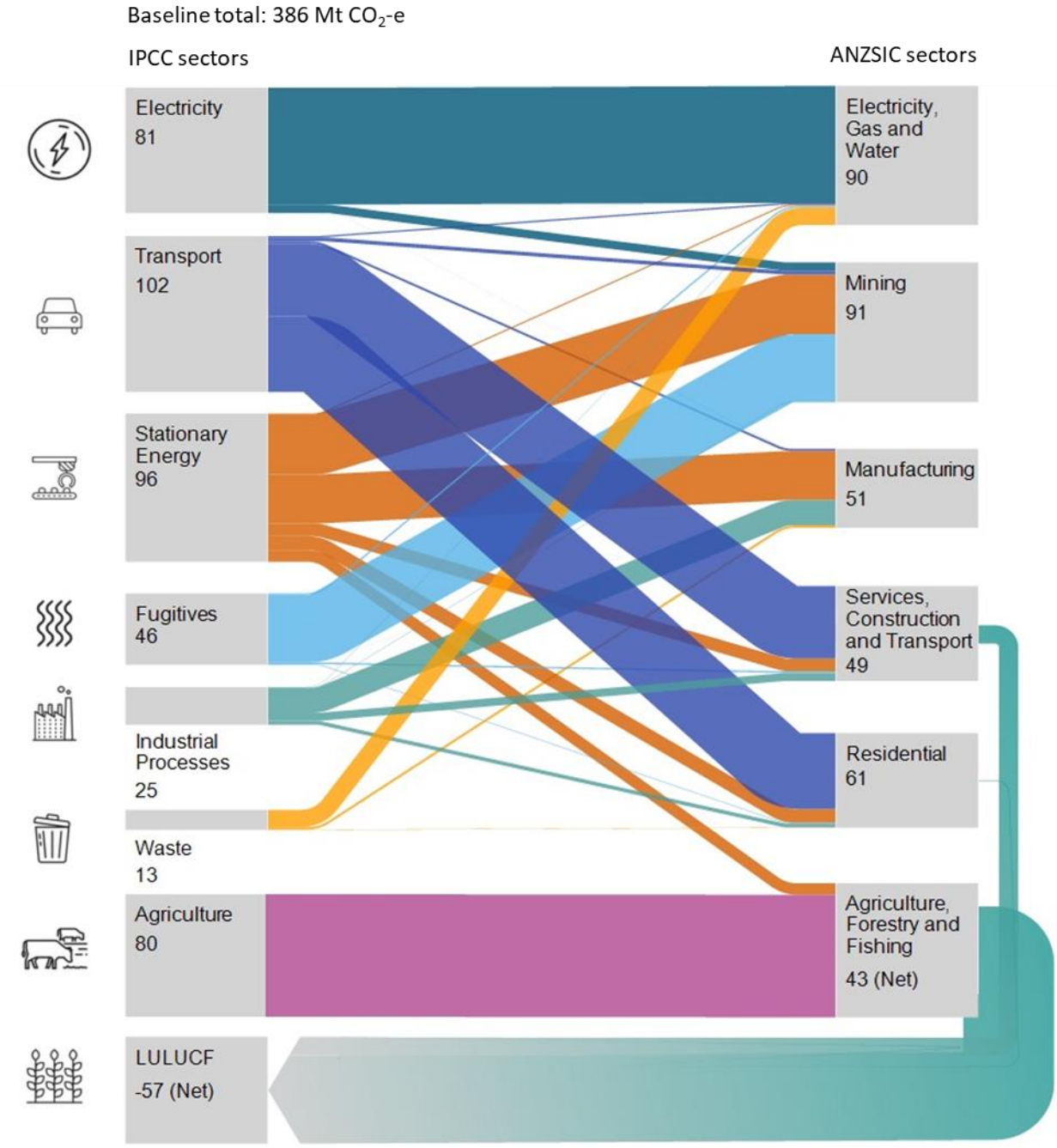
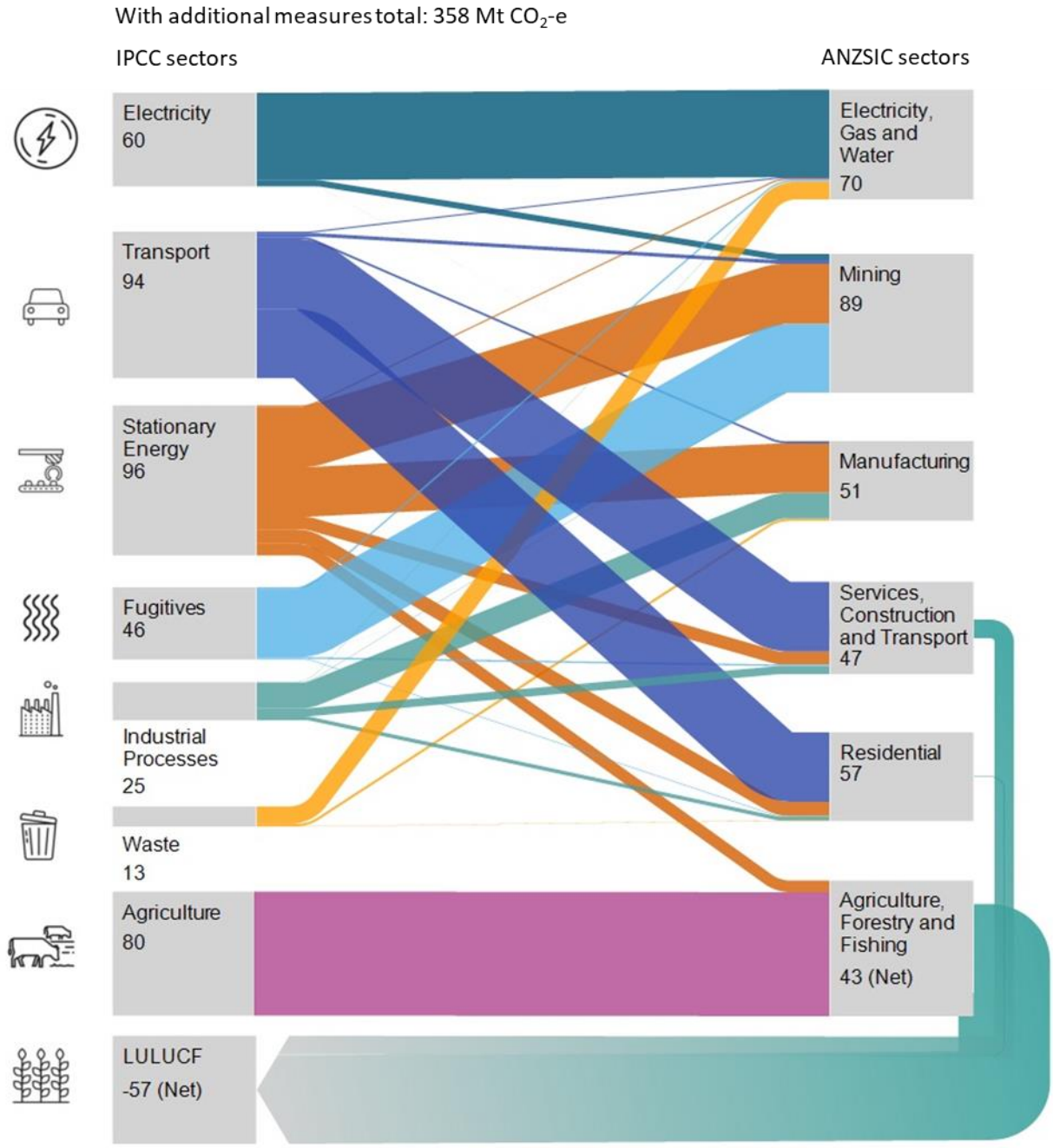


**Figure 38 Australia's emissions projections by economic sector in the baseline scenario, 2030, Mt $CO_2$-e**




Note: totals may not sum due to rounding.

**Figure 39 Australia's emissions projections by economic sector in the 'with additional measures' scenario, 2030, Mt $CO_2$-e**




Note: totals may not sum due to rounding.

# Electricity emission projections by economic sector in the baseline scenario (scope 2 emissions)

In 2023 the electricity sector accounted for around 33% of Australia's emissions. Electricity is transmitted and distributed to a variety of electricity end-users, such as businesses and households.

To better understand how emissions from electricity generation relate to the end-users of that electricity, emissions in this section have been further allocated according to the share of electricity consumption of each economic sector. The emissions projections results have been mapped to economic sectors using the same methodology as is applied for the preparation of the *National Inventory by Economic Sector 2021*.[63]

All economic sectors see declines in emissions from electricity use across the projections period, as the emissions intensity of electricity generation declines (see the electricity chapter, Appendix C and Appendix D for more details).

The share of economic sectors' contributions to total indirect emissions changes over the projections period, as some sectors see faster declines than others. The largest decline is in the residential sector, as households reduce their reliance on electricity purchased from the grid by installing rooftop PV. In 2023 the residential sector accounted for 40 Mt $CO_2$-e of indirect electricity emissions. This is projected to decline by 89% to 4 Mt $CO_2$-e in 2035 and reduce its share of indirect emissions from 26% in 2023 to 12% in 2035 in the baseline and 'with additional measures' scenarios.

By 2035, the mining sector becomes the largest contributor to indirect emissions, as emissions decline more slowly than in other sectors, declining from 25 Mt $CO_2$-e in 2023 to 16 Mt $CO_2$-e and 15 Mt $CO_2$-e in the baseline and 'with additional measures' scenarios respectively. This is because, mining, which relies more on off-grid electricity does not see the same emissions intensity improvements as on grid electricity. At the same time, electricity demand in the mining sector is projected to grow through the electrification of various mining processes. The mining sector increases its share of indirect emissions from 17% in 2023 to 42% in 2035 in the baseline and 46% in 2035 in the 'with additional measures' scenario.

[63] National Greenhouse Accounts 2021: https://www.dcceew.gov.au/climate-change/publications/national-inventory-report-2021

## Table 40 Indirect emissions from the consumption of electricity by economic sector in the baseline scenario, Mt $CO_2$-e

| Emissions by economic sector | 2020 | 2025 | 2030 | 2035 |
|---|---|---|---|---|
| Primary Industries | 28 | 25 | 20 | 16 |
| Agriculture, forestry and fishing | 1 | 1 | <1 | <1 |
| Mining | 27 | 24 | 19 | 16 |
| Manufacturing | 35 | 27 | 17 | 7 |
| Electricity, gas and water | 20 | 15 | 9 | 3 |
| Services, construction and transport | 49 | 35 | 21 | 8 |
| Residential | 40 | 29 | 15 | 4 |
| **Total** | **172** | **132** | **81** | **37** |

## Table 41 Indirect emissions from the consumption of electricity by economic sector in the 'with additional measures' scenario, Mt $CO_2$-e

| Emissions by economic sector | 2020 | 2025 | 2030 | 2035 |
|---|---|---|---|---|
| Primary Industries | 28 | 25 | 18 | 15 |
| Agriculture, forestry and fishing | 1 | 1 | <1 | <1 |
| Mining | 27 | 24 | 17 | 15 |
| Manufacturing | 35 | 27 | 11 | 5 |
| Electricity, gas and water | 20 | 15 | 6 | 3 |
| Services, construction and transport | 49 | 35 | 15 | 6 |
| Residential | 40 | 29 | 10 | 4 |
| **Total** | **172** | **132** | **60** | **32** |

**Figure 40 Emissions from the consumption of electricity by economic sector in the baseline scenario, 2023 to 2035, Mt $CO_2$-e**

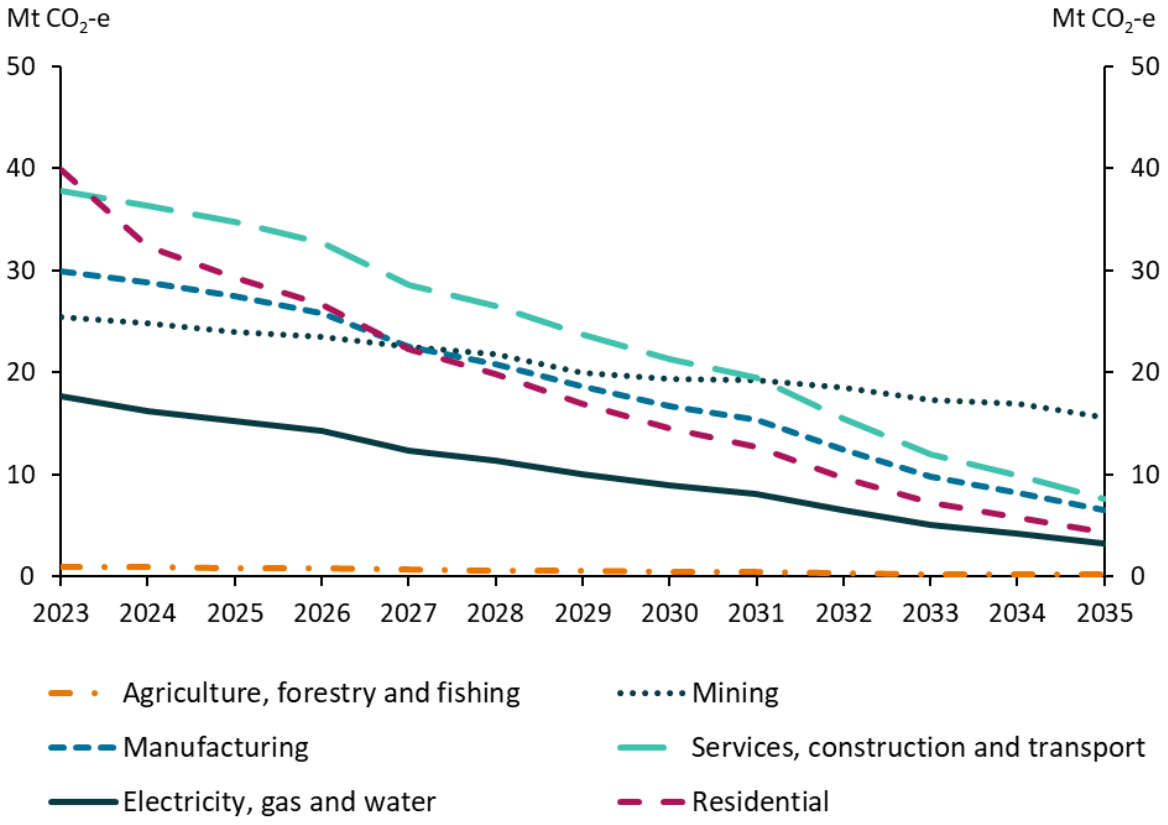
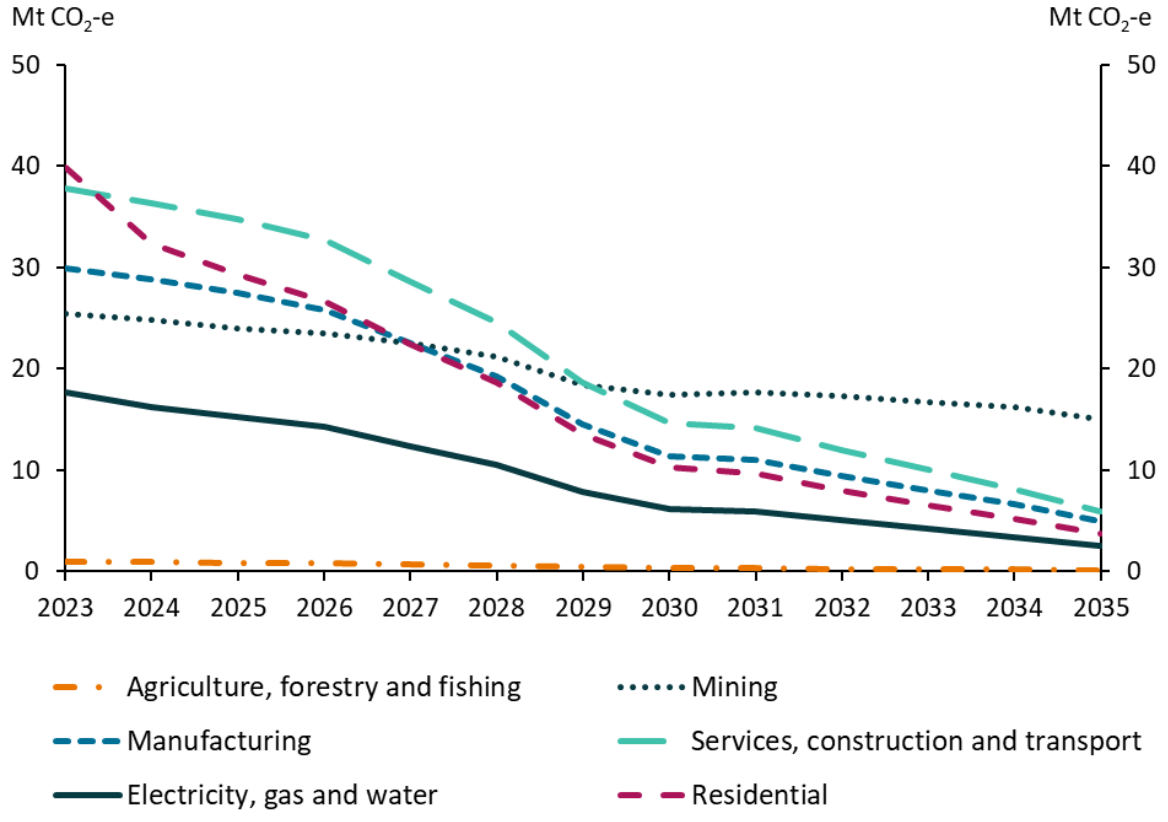



**Figure 41 Emissions from the consumption of electricity by economic sector in the 'with additional measures' scenario, 2023 to 2035, Mt $CO_2$-e**



# Appendix A: Methodology Summary

The detailed methodology for Australia's emissions projections is provided as a separate document alongside this report. The *Methodology for the 2023 Projections* report, can be found on the department's website.

## Accounting approach

The emissions projections are estimated using the UNFCCC accounting approach consistent with Australia's accounting for the 2030 target. Reporting years for all sectors are reported for financial years as key data sources are published on this basis. For instance, '2030' refers to the financial year 2029-30.

Australia's 2030 target and the emissions projections comprises emissions of $CO_2$, $CH_4$, $N_2O$, HFCs, PFCs, $SF_6$ and $NF_3$ across the economy that are included in Australia's annual national greenhouse gas inventory under the UNFCCC. The coverage used by Australia to acquit its Paris Agreement target includes all anthropogenic sources and sinks across Australia's economy and ensures Australia's accounting is complete. This means all anthropogenic emission sources and sinks are captured, and that emissions reductions and sequestration from all sectors of the economy help meet Australia's target.

Emissions from the energy, IPPU, agriculture, and waste sectors are included. The LULUCF sector has both emission sources and sinks that remove or sequester carbon dioxide from the atmosphere.

Emissions estimates are prepared in accordance with the international guidelines agreed for use for the Paris Agreement, including the IPCC 2006 Guidelines for the Preparation of National Greenhouse Gas Inventories and, where applicable, the 2019 IPCC Refinement to the 2006 IPCC Guidelines.

The department applies the 100-year global warming potential values from the IPCC Fifth Assessment Report (AR5) to estimate emissions, consistent with rules adopted under the Paris Agreement (Decision 18/CMA.1 Annex 2.D Paragraph 37).

## Methodology for calculating Australia's cumulative emissions reduction task to 2030

Australia assesses progress against its 2030 target of 43% below 2005 levels using both a point target approach and an emissions budget approach (see Figure 42 and Table 42).

### Point Target

The point target is calculated as a 43% reduction in the year 2030 from 2005 levels. The indicative value of emissions in 2005 is 616 Mt $CO_2$-e making the 2030 target equal to 351 Mt $CO_2$-e. Australia's progress is assessed as the difference between the target emissions and the projected emissions in 2030.

### Emissions Budget

Australia's emissions budget is a 10-year commitment from 2021 to 2030. A trajectory to achieve the emissions budget (4,353 Mt $CO_2$-e) is calculated by taking a linear decline from 2020 to 2030,

beginning from the 2020 target of 5% below 2000 levels and finishing at 43% below 2005 levels in 2030. Australia's progress is assessed as the difference in cumulative emissions between projected emissions and the target trajectory from 2021-2030.

**Figure 42 Tracking against the 2030 emissions reduction target trajectory, 2020 to 2030, Mt $CO_2$-e**

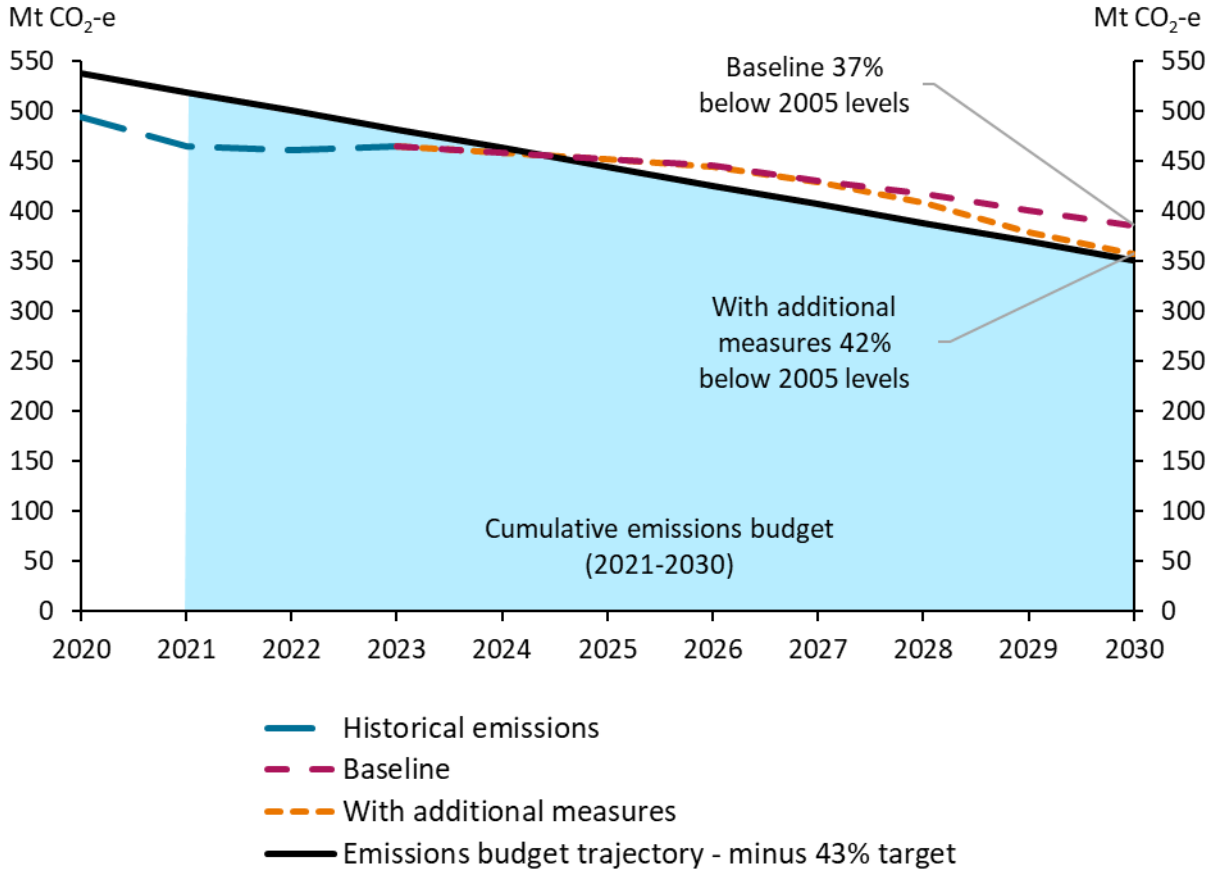



**Table 42 Budget trajectory compared to the projections, Mt $CO_2$-e**

| | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2021-2030 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Budget trajectory (43% target) | 519 | 501 | 482 | 463 | 445 | 426 | 407 | 389 | 370 | 351 | 4,353 |
| Baseline[64] | 465 | 462 | 465 | 459 | 452 | 445 | 431 | 418 | 401 | 386 | 4,384 |
| 'With additional measures' | 465 | 462 | 465 | 459 | 452 | 445 | 429 | 408 | 379 | 358 | 4,322 |

# Emissions projections by economic sector

The report uses the ANZSIC hierarchy from the Australia and New Zealand Standard Industrial Classification 2006 (ABS cat no. 1292.0). The mappings applied are based on the allocation used for the *National Inventory by Economic sector 2021*.

[64] When tracking towards the target in the baseline scenario, the emissions reduction task is adjusted for the voluntary cancellation of ACCUs projected to be 1 Mt $CO_2$-e in 2030 and 8 Mt $CO_2$-e from 2021-2030.

# Key data sources

Key data sources include:

- historical emissions data from the *National Inventory Report 2021*, released in April 2023, and the *Quarterly Update of Australia's National Greenhouse Gas Inventory: June 2023*
- commodity forecasts and activity levels informed by publications and data from government agencies and other bodies, including:
    - the Office of the Chief Economist within the Department of Industry, Science and Resources
    - the ABARES
    - the AEMO
    - the CER.

The department applies consistent assumptions across all sectors of these projections. Sector specific data sources are outlined in the *Methodology for the 2023 emissions projections*.

# Institutional arrangements and quality assurance

The projections are prepared by the Department of Climate Change, Energy, the Environment and Water using the best available data and independent expertise to analyse Australia's future emissions reduction task. The department engages with a technical working group comprising of representatives from Australian Government agencies to test the methodologies, assumptions, and projections results. Australia makes formal submissions on its emissions projections to the UNFCCC and these are subject to review from an expert review team coordinated by the UNFCCC secretariat. The last review was completed in 2020.

The preparation of the emissions projections underwent a performance audit by the Australian National Audit Office (ANAO) over 2016 and 2017. The audit report, *Accounting and Reporting of Australia's Greenhouse Gas Emissions Estimates and Projections* is published on the ANAO website.

# Statement of uncertainty

The Department prepares emissions projections annually using the best data of activity in the economy, information about current policy settings and technology change available at the time of publication. The projections indicate what Australia's future emissions could be if the assumptions that underpin the projections occur. A range of factors, some interrelated, may influence actual emission outcomes in the future. These include:

**Economic outlook** – the emissions projections use macroeconomic parameters and activity data consistent with the 2023-24 Budget and Treasury's 2023 Intergenerational Report. The outlook is uncertain due to domestic and global responses to inflationary pressures, energy price shocks and global conflicts. This has consequences for demand for goods and services in the domestic economy and demand for Australia's exports globally, which in turn impact the emissions outlook. To date, increased activity in the economy has led to increased emissions as well as the inverse, however, the rollout of lower emissions technologies can moderate this impact. Impacts on the demand for Australia's mining, manufacturing and agricultural products have a greater impact on emissions than

other sectors because they are a larger source of Australia's emissions than the rest of the economy, which is predominantly made up of the services sector.

**Implementation of government policies and measures** – the emissions projections assume that policies and the deployable measures announced to realise policy targets are implemented in the timeframe announced. For example, the electricity emissions projections modelling assumes that the Queensland renewable energy targets of 50% in 2030, 70% in 2032 and 80% in 2035 will be met based on announcements in the Queensland Energy and Jobs Plan, including closures of publicly owned Queensland coal power stations and commitment to pumped hydro build to 2035. The emissions projections do not attempt to forecast the impact of potential frictions to successful delivery of policies such as unforeseen delays, supply chain bottlenecks, labour shortages, changes in Government policy or regulatory conditions.

**Technology change** – there are technologies that can abate or reduce greenhouse gas emissions in different sectors of the economy. The uptake and deployment of new technologies is driven by technology readiness, cost, availability and policy and consumer incentives. The price, availability and adoption of technologies such as batteries, CCS, EVs and hydrogen are included in these projections based on the current outlook and expectations for these technologies. Emission outcomes are sensitive to the pace and scale of technology deployment which are uncertain.

**Unforeseen delays –** large capital projects can take many years to plan, approve and execute. Delivery timeliness can be delayed due to challenges in financing, supply chain bottlenecks, delays in environmental approvals, legal challenges to projects and access to relevant labour and expertise. Unforeseen delays could increase projected emissions (for example due to slower than expected build of renewable generation infrastructure or new abatement technologies) or decrease emissions (for example from delays in the build and ramp up of new fossil fuel, mining and manufacturing projects).

**Risk associated with climate change** – there is uncertainty about the impacts that climate change will have on Australia. These include the physical impacts of climate change, particularly on the agriculture and the LULUCF sectors where emissions sources and sinks are sensitive to more frequent and intense climate events. It is also evident in the emissions in other sectors based on recent history: temporary closures or disruptions at coal and LNG facilities because of flooding and cyclones, increased demand for electricity during extreme heat, and historic low levels of hydro generation during the millennium drought.

# Appendix B: Consideration of policies

The baseline emissions projections take account of current policies and measures and announced policies where there is sufficient detail to make robust assumptions in the modelling. Key policies included in the baseline scenario are listed in Table 43.

**Table 43 Key policies in the baseline scenario**

| Jurisdiction | Existing policies | New or updated policies since the 2022 emissions projections |
|---|---|---|
| Commonwealth | **Powering Australia Plan** | **Powering Australia Plan** |
| | Rewiring the Nation, to the extent that it supports delivery of state and territory renewable targets and plans | Safeguard Mechanism reforms |
| | Community Batteries for Household Solar Program | Powering the Regions Fund (Safeguard Transformation Stream) |
| | Community Solar Banks program | Some measures under the National Electric Vehicle Strategy including the Fringe Benefits Tax exemption |
| | Powering the Regions Fund (Government purchases of Australian Carbon Credit Units) | Household Energy Upgrades Fund, in the 2023-24 Budget |
| | Large-scale Renewable Energy Target | Capacity Investment Scheme, as per public announcements to August 30th, 2023. |
| | Small-scale Renewable Energy Scheme | Renewable Energy Guarantee of Origin |
| | Australian Carbon Credit Unit Scheme | |
| | Federal energy efficiency measures | |
| State and territory | Victoria's Energy Storage Targets and Offshore Wind Targets | Victoria's updated state renewable energy target (65% by 2030, and 95% by 2035) |
| | New South Wales Electricity Infrastructure Road Map | Victoria - cessation of native forest harvesting updated from 2031 to 2024 |
| | Queensland Energy and Jobs Plan and Queensland's state renewable energy target (50% in 2030, 70% in 2032 and 80% in 2035) | |
| | Tasmania's state renewable target (150% in 2030) | |
| | The Northern Territory's renewable target (50% in 2030) | |
| | Western Australia's closure of Collie and Muja D coal power stations and renewables announcement | |
| | State and territory energy efficiency measures | |
| | State and territory measures to incentivise electric vehicle uptake | |
| | Western Australia – cessation of native forest harvesting from 2024 | |
| | State and territory commitments to food organics and garden organics bin rollout | |

The 'with additional measures' scenario is intended to show the potential impact on emissions from policies that have been announced but where detailed design is still under consultation. The 2023 emissions projections 'with additional measures' scenario includes:

- a national renewable electricity target of 82% by 2030
- further measures under the National Electric Vehicle Strategy including a fuel efficiency standard for light vehicles.

Assumptions have been made about key design aspects of these policies for modelling purposes. These should not be interpreted as final policy decisions.

There are some federal, state and territory policies and measures that have been announced since the previous emissions projections but have not been included in the 2023 projections. This is because they are at an earlier stage of design, there is insufficient detail to enable reasonable assumptions to be made to model the impact (e.g., timing, location, funding, pace of deployment), or estimating their impact is dependent on grants round that have not been run or investment decisions that have not been made. These policies include:

- Powering the Regions Fund (Industrial Transformation and Critical Inputs to Clean Energy Industries streams)
- the National Reconstruction Fund
- the Hydrogen Headstart program
- Western Australia's Green Hydrogen target
- South Australia's Hydrogen Jobs Plan
- the expansion of the Capacity Investment Scheme announced on 23 November 2023
- Renewable Energy Transformation Agreements.

# Appendix C: Emissions projections by year

The data presented in Table 44 shows Australia's annual emissions projections for each year from 2023 to 2035 in Mt $CO_2$-e and as a per cent reduction on 2005 (as the base year of Australia's 2030 target) and 2023 (current) levels.

**Table 44 Australia's emissions projections by scenario, Mt $CO_2$-e, % change on 2005 and 2023**

| Year | Baseline Mt $CO_2$-e | Baseline % change on 2005 | Baseline % change on 2023 | 'With additional measures' Mt $CO_2$-e | 'With additional measures' % change on 2005 | 'With additional measures' % change on 2023 |
|---|---|---|---|---|---|---|
| **2005** | **616** | **0%** | | **616** | **0%** | |
| 2023 | 465 | -25% | 0% | 465 | -25% | 0% |
| 2024 | 459 | -26% | -1% | 459 | -26% | -1% |
| 2025 | 452 | -27% | -3% | 452 | -27% | -3% |
| 2026 | 445 | -28% | -4% | 445 | -28% | -4% |
| 2027 | 431 | -30% | -7% | 429 | -30% | -8% |
| 2028 | 418 | -32% | -10% | 408 | -34% | -12% |
| 2029 | 401 | -35% | -14% | 379 | -38% | -18% |
| **2030** | **386** | **-37%** | **-17%** | **358** | **-42%** | **-23%** |
| 2031 | 379 | -38% | -18% | 354 | -43% | -24% |
| 2032 | 359 | -42% | -23% | 337 | -45% | -27% |
| 2033 | 339 | -45% | -27% | 320 | -48% | -31% |
| 2034 | 328 | -47% | -30% | 308 | -50% | -34% |
| **2035** | **313** | **-49%** | **-33%** | **292** | **-53%** | **-37%** |

# Appendix D: Projected emissions factors for Australia's electricity grid in the baseline scenario

Table 45 and Table 46 contain emission factors for Australia's electricity grid in the baseline scenario, consistent with the results presented in the electricity chapter of this report.

**Table 45 Indirect scope 2[65] emissions factors in the baseline scenario, tonnes $CO_2$-e per MWh**

| | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Australia, all grid connected | 0.65 | 0.60 | 0.55 | 0.50 | 0.42 | 0.38 | 0.32 | 0.28 | 0.24 | 0.19 | 0.14 | 0.11 | 0.08 |
| National Electricity Market | 0.66 | 0.60 | 0.56 | 0.51 | 0.43 | 0.39 | 0.33 | 0.29 | 0.25 | 0.19 | 0.14 | 0.10 | 0.07 |
| New South Wales/ Australian Capital Territory | 0.68 | 0.59 | 0.52 | 0.39 | 0.29 | 0.28 | 0.27 | 0.19 | 0.11 | 0.06 | 0.02 | 0.03 | 0.03 |
| Queensland | 0.73 | 0.70 | 0.67 | 0.65 | 0.55 | 0.46 | 0.42 | 0.40 | 0.36 | 0.27 | 0.19 | 0.18 | 0.18 |
| South Australia | 0.25 | 0.17 | 0.14 | 0.13 | 0.06 | 0.08 | 0.08 | 0.06 | 0.08 | 0.09 | 0.11 | 0.14 | 0.16 |
| Victoria | 0.79 | 0.75 | 0.70 | 0.68 | 0.63 | 0.59 | 0.40 | 0.39 | 0.38 | 0.31 | 0.24 | 0.12 | 0.01 |
| Tasmania | 0.12 | 0.05 | 0.02 | 0.04 | 0.04 | 0.03 | 0.02 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| Western Australia's Wholesale Electricity Market | 0.53 | 0.50 | 0.47 | 0.44 | 0.34 | 0.29 | 0.27 | 0.18 | 0.18 | 0.16 | 0.15 | 0.15 | 0.14 |
| North West Interconnected System | 0.62 | 0.58 | 0.54 | 0.47 | 0.40 | 0.35 | 0.30 | 0.26 | 0.24 | 0.22 | 0.21 | 0.19 | 0.18 |
| Darwin-Katherine Interconnected System | 0.54 | 0.52 | 0.39 | 0.37 | 0.35 | 0.35 | 0.34 | 0.31 | 0.27 | 0.27 | 0.27 | 0.27 | 0.26 |

[65] Scope 2 emissions are from the generation of the electricity purchased and consumed by an organisation. Scope 2 emissions are physically produced by the burning of fuels (coal, natural gas, etc.) at the power station.

**Table 46 Indirect scope 2 and 3[66] combined emissions factors in the baseline scenario, tonnes $CO_2$-e per MWh**

| | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Australia, all grid connected | 0.73 | 0.67 | 0.62 | 0.57 | 0.48 | 0.43 | 0.36 | 0.31 | 0.28 | 0.21 | 0.16 | 0.13 | 0.10 |
| National Electricity Market | 0.74 | 0.68 | 0.63 | 0.57 | 0.49 | 0.44 | 0.37 | 0.32 | 0.28 | 0.21 | 0.15 | 0.12 | 0.08 |
| New South Wales/ Australian Capital Territory | 0.73 | 0.63 | 0.56 | 0.42 | 0.32 | 0.30 | 0.30 | 0.20 | 0.11 | 0.06 | 0.02 | 0.03 | 0.03 |
| Queensland | 0.88 | 0.85 | 0.80 | 0.78 | 0.67 | 0.56 | 0.51 | 0.48 | 0.44 | 0.32 | 0.23 | 0.22 | 0.22 |
| South Australia | 0.32 | 0.22 | 0.18 | 0.17 | 0.08 | 0.10 | 0.10 | 0.08 | 0.11 | 0.12 | 0.14 | 0.19 | 0.21 |
| Victoria | 0.85 | 0.81 | 0.75 | 0.74 | 0.69 | 0.64 | 0.43 | 0.42 | 0.41 | 0.34 | 0.26 | 0.13 | 0.01 |
| Tasmania | 0.13 | 0.05 | 0.02 | 0.04 | 0.04 | 0.03 | 0.03 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | 0.02 |
| Western Australia's Wholesale Electricity Market | 0.57 | 0.54 | 0.51 | 0.47 | 0.37 | 0.31 | 0.29 | 0.20 | 0.19 | 0.17 | 0.16 | 0.16 | 0.15 |
| North West Interconnected System | 0.67 | 0.63 | 0.58 | 0.50 | 0.43 | 0.37 | 0.32 | 0.28 | 0.26 | 0.24 | 0.22 | 0.21 | 0.20 |
| Darwin-Katherine Interconnected System | 0.61 | 0.59 | 0.44 | 0.42 | 0.40 | 0.39 | 0.38 | 0.35 | 0.31 | 0.30 | 0.30 | 0.30 | 0.29 |

[66] Scope 2 emissions are from the generation of the electricity purchased and consumed by an organisation. Scope 2 emissions are physically produced by the burning of fuels (coal, natural gas, etc.) at the power station. Scope 3 emissions are indirect emissions from the extraction, production and transport of fuel burned at generation and the indirect emissions attributable to the electricity lost in delivery in the Transmission and Distribution network. (Source: National Greenhouse Accounts Factors 2023)

# Appendix E: Projected emissions factors for Australia's electricity grid in the 'with additional measures' scenario

Table 47 and Table 48 contain emission factors for Australia's electricity grid in the 'with additional measures' scenario, consistent with the results presented in the electricity chapter of this report.

**Table 47 Indirect scope 2[67] emissions factors in the 'with additional measures' scenario, tonnes $CO_2$-e per MWh**

| | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Australia, all grid connected | 0.65 | 0.60 | 0.55 | 0.50 | 0.42 | 0.35 | 0.25 | 0.19 | 0.17 | 0.14 | 0.12 | 0.09 | 0.06 |
| National Electricity Market | 0.66 | 0.60 | 0.56 | 0.51 | 0.43 | 0.36 | 0.26 | 0.20 | 0.18 | 0.15 | 0.12 | 0.09 | 0.06 |
| New South Wales/ Australian Capital Territory | 0.68 | 0.59 | 0.52 | 0.39 | 0.29 | 0.26 | 0.17 | 0.09 | 0.06 | 0.02 | 0.02 | 0.02 | 0.03 |
| Queensland | 0.73 | 0.70 | 0.67 | 0.65 | 0.55 | 0.42 | 0.34 | 0.22 | 0.22 | 0.19 | 0.15 | 0.15 | 0.15 |
| South Australia | 0.25 | 0.17 | 0.14 | 0.13 | 0.06 | 0.06 | 0.07 | 0.06 | 0.06 | 0.07 | 0.07 | 0.09 | 0.11 |
| Victoria | 0.79 | 0.75 | 0.70 | 0.68 | 0.63 | 0.56 | 0.36 | 0.37 | 0.35 | 0.30 | 0.22 | 0.12 | <0.01 |
| Tasmania | 0.12 | 0.05 | 0.02 | 0.04 | 0.04 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Western Australia's Wholesale Electricity Market | 0.53 | 0.50 | 0.47 | 0.44 | 0.34 | 0.23 | 0.18 | 0.11 | 0.11 | 0.09 | 0.09 | 0.08 | 0.07 |
| North West Interconnected System | 0.62 | 0.58 | 0.54 | 0.47 | 0.37 | 0.29 | 0.22 | 0.14 | 0.14 | 0.13 | 0.13 | 0.13 | 0.13 |
| Darwin-Katherine Interconnected System | 0.54 | 0.52 | 0.39 | 0.37 | 0.35 | 0.22 | 0.17 | 0.11 | 0.11 | 0.10 | 0.10 | 0.10 | 0.10 |

[67] Scope 2 emissions are from the generation of the electricity purchased and consumed by an organisation. Scope 2 emissions are physically produced by the burning of fuels (coal, natural gas, etc.) at the power station.

**Table 48 Indirect scope 2 and 3[68] combined emissions factors in the 'with additional measures' scenario, tonnes $CO_2$-e per MWh**

| | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Australia, all grid connected | 0.73 | 0.67 | 0.62 | 0.57 | 0.47 | 0.39 | 0.28 | 0.21 | 0.20 | 0.16 | 0.13 | 0.10 | 0.07 |
| National Electricity Market | 0.74 | 0.68 | 0.63 | 0.57 | 0.49 | 0.41 | 0.29 | 0.22 | 0.21 | 0.17 | 0.13 | 0.10 | 0.07 |
| New South Wales/ Australian Capital Territory | 0.73 | 0.63 | 0.56 | 0.42 | 0.32 | 0.28 | 0.18 | 0.09 | 0.06 | 0.02 | 0.02 | 0.02 | 0.03 |
| Queensland | 0.88 | 0.85 | 0.80 | 0.78 | 0.66 | 0.51 | 0.41 | 0.27 | 0.26 | 0.23 | 0.19 | 0.18 | 0.18 |
| South Australia | 0.32 | 0.22 | 0.18 | 0.17 | 0.08 | 0.08 | 0.09 | 0.08 | 0.08 | 0.09 | 0.09 | 0.12 | 0.14 |
| Victoria | 0.85 | 0.81 | 0.75 | 0.74 | 0.69 | 0.61 | 0.39 | 0.40 | 0.38 | 0.32 | 0.24 | 0.13 | <0.01 |
| Tasmania | 0.13 | 0.05 | 0.02 | 0.04 | 0.04 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Western Australia's Wholesale Electricity Market | 0.57 | 0.54 | 0.51 | 0.47 | 0.37 | 0.25 | 0.20 | 0.12 | 0.12 | 0.10 | 0.09 | 0.09 | 0.08 |
| North West Interconnected System | 0.67 | 0.63 | 0.58 | 0.50 | 0.39 | 0.31 | 0.24 | 0.15 | 0.15 | 0.14 | 0.14 | 0.14 | 0.14 |
| Darwin-Katherine Interconnected System | 0.61 | 0.59 | 0.44 | 0.42 | 0.40 | 0.25 | 0.19 | 0.12 | 0.12 | 0.12 | 0.11 | 0.11 | 0.11 |

[68] Scope 2 emissions are from the generation of the electricity purchased and consumed by an organisation. They are physically produced by the burning of fuels (coal, natural gas, etc.) at the power station. Scope 3 emissions are indirect emissions from the extraction, production and transport of fuel burned at generation and the indirect emissions attributable to the electricity lost in delivery in the Transmission and Distribution network. (Source: National Greenhouse Accounts Factors 2023)